AD NO. ___________________________
DTC PROJECT NO. 8-CO-160-UXO-021
REPORT NO. ATC-9093

STANDARDIZED

UXO TECHNOLOGY DEMONSTRATION SITE

BLIND GRID SCORING RECORD NO. 281

SITE LOCATION:
U.S. ARMY ABERDEEN PROVING GROUND

DEMONSTRATOR:
GEOPHYSICAL TECHNOLOGY LIMITED (G-TEK)
UNIT 3, NO. 10, HUDSON ROAD
ALBION, AUSTRALIA   4010

TECHNOLOGY TYPE/PLATFORM:
SUB-AUDIO MAGNETICS (SAM)/SLING
DUAL MODE

PREPARED BY:
U.S. ARMY ABERDEEN TEST CENTER
ABERDEEN PROVING GROUND, MD   21005-5059

SEPTEMBER 2005

Prepared for:
U.S. ARMY ENVIRONMENTAL CENTER
ABERDEEN PROVING GROUND, MD   21010-5401

U.S. ARMY DEVELOPMENTAL TEST COMMAND
ABERDEEN PROVING GROUND, MD   21005-5055

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14. ABSTRACT This scoring record documents the efforts of Geophysical Technology Limited (G-TEK) to detect and discriminate inert unexploded ordnance (UXO) utilizing the APG Standardized UXO Technology Demonstration Site Blind Grid. Scoring Records have been coordinated by Larry Overbay and the Standardized UXO Technology Demonstration Site Scoring Committee. Organizations on the committee include, the U.S. Army Corps of Engineers, the Environmental Security Technology Certification Program, the Strategic Environmental Research and Development Program, the Institute for Defense Analysis, the U.S. Army Environmental Center, and the U.S. Army Aberdeen Test Center.						
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SECTION 1. GENERAL INFORMATION

1.1 BACKGROUND

Technologies under development for the detection and discrimination of unexploded ordnance (UXO) require testing so that their performance can be characterized. To that end, Standardized Test Sites have been developed at Aberdeen Proving Ground (APG), Maryland and U.S. Army Yuma Proving Ground (YPG), Arizona. These test sites provide a diversity of geology, climate, terrain, and weather as well as diversity in ordnance and clutter. Testing at these sites is independently administered and analyzed by the government for the purposes of characterizing technologies, tracking performance with system development, comparing performance of different systems, and comparing performance in different environments.

The Standardized UXO Technology Demonstration Site Program is a multi-agency program spearheaded by the U.S. Army Environmental Center (AEC). The U.S. Army Aberdeen Test Center (ATC) and the U.S. Army Corps of Engineers Engineering Research and Development Center (ERDC) provide programmatic support. The program is being funded and supported by the Environmental Security Technology Certification Program (ESTCP), the Strategic Environmental Research and Development Program (SERDP) and the Army Environmental Quality Technology Program (EQT).

1.2 SCORING OBJECTIVES

The objective in the Standardized UXO Technology Demonstration Site Program is to evaluate the detection and discrimination capabilities of a given technology under various field and soil conditions. Inert munitions and clutter items are positioned in various orientations and depths in the ground.

The evaluation objectives are as follows:

a. To determine detection and discrimination effectiveness under realistic scenarios that vary targets, geology, clutter, topography, and vegetation.

b. To determine cost, time, and manpower requirements to operate the technology.

c. To determine demonstrator's ability to analyze survey data in a timely manner and provide prioritized "Target Lists" with associated confidence levels.

d. To provide independent site management to enable the collection of high quality, ground-truth, geo-referenced data for post-demonstration analysis.

1.2.1 Scoring Methodology

a. The scoring of the demonstrator's performance is conducted in two stages. These two stages are termed the RESPONSE STAGE and DISCRIMINATION STAGE. For both stages, the probability of detection (P_d) and the false alarms are reported as receiver-operating characteristic (ROC) curves. False alarms are divided into those anomalies that correspond to emplaced clutter items, measuring the probability of false positive (P_{fp}), and those that do not correspond to any known item, termed background alarms.

b. The RESPONSE STAGE scoring evaluates the ability of the system to detect emplaced targets without regard to ability to discriminate ordnance from other anomalies. For the blind grid RESPONSE STAGE, the demonstrator provides the scoring committee with a target response from each and every grid square along with a noise level below which target responses are deemed insufficient to warrant further investigation. This list is generated with minimal processing and, since a value is provided for every grid square, will include signals both above and below the system noise level.

c. The DISCRIMINATION STAGE evaluates the demonstrator's ability to correctly identify ordnance as such and to reject clutter. For the blind grid DISCRIMINATION STAGE, the demonstrator provides the scoring committee with the output of the algorithms applied in the discrimination-stage processing for each grid square. The values in this list are prioritized based on the demonstrator's determination that a grid square is likely to contain ordnance. Thus, higher output values are indicative of higher confidence that an ordnance item is present at the specified location. For digital signal processing, priority ranking is based on algorithm output. For other discrimination approaches, priority ranking is based on human (subjective) judgment. The demonstrator also specifies the threshold in the prioritized ranking that provides optimum performance, (i.e. that is expected to retain all detected ordnance and rejects the maximum amount of clutter).

d. The demonstrator is also scored on EFFICIENCY and REJECTION RATIO, which measures the effectiveness of the discrimination stage processing. The goal of discrimination is to retain the greatest number of ordnance detections from the anomaly list, while rejecting the maximum number of anomalies arising from non-ordnance items. EFFICIENCY measures the fraction of detected ordnance retained after discrimination, while the REJECTION RATIO measures the fraction of false alarms rejected. Both measures are defined relative to performance at the demonstrator-supplied level below which all responses are considered noise, i.e., the maximum ordnance detectable by the sensor and its accompanying false positive rate or background alarm rate.

e. All scoring factors are generated utilizing the Standardized UXO Probability and Plot Program, version 3.1.1.

1.2.2 Scoring Factors

Factors to be measured and evaluated as part of this demonstration include:

a. Response Stage ROC curves:

(1) Probability of Detection (P_d^{res}).

(2) Probability of False Positive (P_{fp}^{res}).

(3) Background Alarm Rate (BAR^{res}) or Probability of Background Alarm (P_{BA}^{res}).

b. Discrimination Stage ROC curves:

(1) Probability of Detection (P_d^{disc}).

(2) Probability of False Positive (P_{fp}^{disc}).

(3) Background Alarm Rate (BAR^{disc}) or Probability of Background Alarm (P_{BA}^{disc}).

c. Metrics:

(1) Efficiency (E).

(2) False Positive Rejection Rate (R_{fp}).

(3) Background Alarm Rejection Rate (R_{BA}).

d. Other:

(1) Probability of Detection by Size and Depth.

(2) Classification by type (i.e., 20-mm, 40-mm, 105-mm, etc.).

(3) Location accuracy.

(4) Equipment setup, calibration time and corresponding man-hour requirements.

(5) Survey time and corresponding man-hour requirements.

(6) Reacquisition/resurvey time and man-hour requirements (if any).

(7) Downtime due to system malfunctions and maintenance requirements.

1.3 STANDARD AND NONSTANDARD INERT ORDNANCE TARGETS

The standard and nonstandard ordnance items emplaced in the test areas are listed in Table 1. Standardized targets are members of a set of specific ordnance items that have identical properties to all other items in the set (caliber, configuration, size, weight, aspect ratio, material, filler, magnetic remanence, and nomenclature). Nonstandard targets are ordnance items having properties that differ from those in the set of standardized targets.

TABLE 1. INERT ORDNANCE TARGETS

Standard Type	Nonstandard (NS)
20-mm Projectile M55	20-mm Projectile M55
	20-mm Projectile M97
40-mm Grenades M385	40-mm Grenades M385
40-mm Projectile MKII Bodies	40-mm Projectile M813
BDU-28 Submunition	
BLU-26 Submunition	
M42 Submunition	
57-mm Projectile APC M86	
60-mm Mortar M49A3	60-mm Mortar (JPG)
	60-mm Mortar M49
2.75-inch Rocket M230	2.75-inch Rocket M230
	2.75-inch Rocket XM229
MK 118 ROCKEYE	
81-mm Mortar M374	81-mm Mortar (JPG)
	81-mm Mortar M374
105-mm HEAT Rounds M456	
105-mm Projectile M60	105-mm Projectile M60
155-mm Projectile M483A1	155-mm Projectile M483A
	500-lb Bomb
	M75 Submunition

JPG = Jefferson Proving Ground.
HEAT = high-explosive, antitank

SECTION 2. DEMONSTRATION

2.1 DEMONSTRATOR INFORMATION

2.1.1 Demonstrator Point of Contact (POC) and Address

Geophysical Technology Limited (G-TEK)
Unit 3, No. 10, Hudson Road
Albion, Australia 4010

2.1.2 System Description (provided by demonstrator)

Sub-Audio Magnetics (SAM) is a method by which a total field-magnetometer sampling at a very high rate may be used to simultaneously acquire both Total Magnetic Intensity (TMI) and Total Field Electromagnetic Induction (TFEMI) data. The SAM system consists of the following components:

Magnetometer:

The SAM capable TM-6 magnetometer to be used has been developed and built by G-TEK. Its salient features include:

1. Accepts Larmor signal input from a hand-held array of four optically pumped magnetic sensors.

2. Simultaneously acquires magnetic field measurements from each sensor at selectable rates up to 4,800 per second.

3. Acquires measurements at precise intervals of time in synchronization with Global Positioning System (GPS) time.

4. The root-mean-square (RMS) noise floor for each measurement sample rate typically lies between 1 nT at 10,000 per second to 1 pT at 100 per second when plotted on a logarithmic abscissa. In this program we propose sampling at 4,800 per second where the noise is approximately 0.2 nT, reducible in late-time by the averaging of consecutive samples.

5. Accepts position and time information including 1-pps strobe from Differential Global Positioning System (DGPS).

6. Magnetometer, DGPS, and batteries to power a quad-sensor array for 2.5 hours are carried in a backpack weighing about 8 kg.

7. Graphic user interface implemented on a Pocket PC.

Electromagnetic Transmitter:

An eight-turn wire loop is laid out along a meandering path that surrounds the grid area to be surveyed (typically 33 by 33 m). A Zonge GGT-10 current transmitter energizes this loop with a bipolar, 12- to 20-amp square wave current usually of 50 percent duty cycle and 15 Hz frequency. The transmitter and receiving magnetometer are precisely synchronized using GPS time.

Data Positioning Systems:

The TM-6 magnetometer system has been designed to interface with a variety of positioning devices as different application localities have different characteristics and requirements. There is a requirement when using the magnetometer for SAM applications that access is available to GPS time at least once every 30 minutes in order to maintain precise clock synchronization. However, this time signal may be obtainable in conditions such as wooded areas where DGPS positional accuracy is not satisfactory. In such situations, a cotton thread based odometer system developed by G-TEK and used for more than 25 years, provides a good alternative. However, emerging new technologies such as the Robotic Total Station (RTS) have been allowed for in the design of the magnetometer. At the APG site it is proposed that both the odometer and RTS will be used in the forested area for the purpose of evaluating their relative performance.

Figure 1. Demonstrator's system, SAM/SLING dual mode.

2.1.3 Data Processing Description (provided by demonstrator)

The raw TM-6 data is processed using a proprietary software package referred to as MagPi which performs all preprocessing procedures including separation of the magnetic TMI and electromagnetic (EM) data TFEMI sets, waveform stacking, removal of unwanted frequency components such as 60 Hz noise, EM decay curve integration, decimation, merging of DGPS time/position and low-pass filtering. The MagPi output is usually in the form of Excel style comma separated values (CSV) files (time decays) or Geosoft XYZ files. The Geosoft Mapping Package is used for data management, gridding, map creation and display and other specialized filtering. Two proprietary products referred to as MagSys (G-TEK) and UXOlab (University of British Columbia) are used for additional interpretation of the gridded data, in order to provide automatic anomaly picking, calculation of certain anomaly parameters, forward modeling, and inversion. The SAM electromagnetic interface (EMI) method provides two complementary data sets (TMI and TFEMI) that are perfectly georeferenced because the same sensor is used to acquire both data types simultaneously. For these technology demonstrations the individual data sets will be processed separately to the point of producing the XYZ files, but the results will be presented as a single joint interpretation, using selected information from each data set combined in a logical and optimal manner. In the specific case of small ordnance items such as grenades and submunitions, the TFEMI response is likely to be below the noise floor with the TFEMI, in which case the interpretation will be based on the TMI alone.

2.1.4 Data Submission Format

Data were submitted for scoring in accordance with data submission protocols outlined in the Standardized UXO Technology Demonstration Site Handbook. These submitted data are not included in this report in order to protect ground truth information.

2.1.5 Demonstrator Quality Assurance (QA) and Quality Control (QC) (provided by demonstrator)

Overview of QC. Prior to the commencement of survey each day, a system integrity test procedure will be conducted exceeding the requirements of DID 005 05.02. This procedure, described in Appendix D, will include:

1. A test for sensor warm-up and signal health.

2. The testing of personnel for demagnetization and metal-free clothing.

3. A cable vibration test in conjunction with in-built system integrity checks.

4. A sensor array position check.

5. Acquiring a DGPS latency, sensor offset, and data integrity record using a six-line test performed over the energized wire loop.

6. A heading and azimuthal test.

7. A repeat line test.

8. Occupying a known position and recording its measured position.

Overview of QA. The most important aspect of quality assurance for this demonstration is that all measurements are accurately recorded and well documented. Detailed signed and dated field notes will accompany all digital data files. The QA officer (JMS) will independently evaluate the calibration data files and the demonstration survey data files. Data not compliant with the survey specifications will be reacquired.

2.1.6 Additional Records

The following record(s) by this vendor can be accessed via the Internet as MicroSoft Word documents at www.uxotestsites.org.

2.2 APG SITE INFORMATION

2.2.1 Location

The APG Standardized Test Site is located within a secured range area of the Aberdeen Area of APG. The Aberdeen Area of APG is located approximately 30 miles northeast of Baltimore at the northern end of the Chesapeake Bay. The Standardized Test Site encompasses 17 acres of upland and lowland flats, woods, and wetlands.

2.2.2 Soil Type

According to the soils survey conducted for the entire area of APG in 1998, the test site consists primarily of Elkton Series type soil (ref 2). The Elkton Series consists of very deep, slowly permeable, poorly drained soils. These soils formed in silty aeolin sediments and the underlying loamy alluvial and marine sediments. They are on upland and lowland flats and in depressions of the Mid-Atlantic Coastal Plain. Slopes range from 0 to 2 percent.

ERDC conducted a site-specific analysis in May of 2002 (ref 3). The results basically matched the soil survey mentioned above. Seventy percent of the samples taken were classified as silty loam. The majority (77 percent) of the soil samples had a measured water content between 15- and 30-percent with the water content decreasing slightly with depth.

For more details concerning the soil properties at the APG test site, go to www.uxotestsites.org on the web to view the entire soils description report.

2.2.3 Test Areas

A description of the test site areas at APG is included in Table 2.

TABLE 2. TEST SITE AREAS

Area	Description
Calibration Grid	Contains 14 standard ordnance items buried in six positions at various angles and depths to allow demonstrator equipment calibration.
Blind Grid	Contains 400 grid cells in a 0.2-hectare (0.5 acre) site. The center of each grid cell contains ordnance, clutter or nothing.

SECTION 3. FIELD DATA

3.1 DATE OF FIELD ACTIVITIES (24 May and 4 June 2004)

3.2 AREAS TESTED/NUMBER OF HOURS

Areas tested and total number of hours operated at each site are summarized in Table 3.

TABLE 3. AREAS TESTED AND NUMBER OF HOURS

Area	Number of Hours
Calibration Lanes	2.66
Blind Grid	3.92

3.3 TEST CONDITIONS

3.3.1 Weather Conditions

An APG weather station located approximately one mile west of the test site was used to record average temperature and precipitation on a half hour basis for each day of operation. The temperatures listed in Table 4 represent the average temperature during field operations from 0700 to 1700 hours while precipitation data represents a daily total amount of rainfall. Hourly weather logs used to generate this summary are provided in Appendix B.

TABLE 4. TEMPERATURE/PRECIPITATION DATA SUMMARY

Date, 2004	Average Temperature, ^{o}F	Total Daily Precipitation, in.
24 May	83.75	0.00
4 June	69.63	0.00

3.3.2 Field Conditions

G-TEK surveyed the Blind Grid on 24 May and 4 June. The Calibration Lane and Blind Grid had several muddy areas due to rain prior to and during testing.

3.3.3 Soil Moisture

Three soil probes were placed at various locations within the site to capture soil moisture data: Calibration, Mogul, Open Field, and Wooded areas. Measurements were collected in percent moisture and were taken twice daily (morning and afternoon) from five different soil depths (1 to 6 in., 6 to 12 in., 12 to 24 in., 24 to 36 in., and 36 to 48 in.) from each probe. Soil moisture logs are included in Appendix C.

3.4 FIELD ACTIVITIES

3.4.1 Setup/Mobilization

These activities included initial mobilization and daily equipment preparation and break down. A five-person crew took 5 hours to perform the initial setup and mobilization. There was 30 minutes of daily equipment preparation and no end of the day equipment break down took place.

3.4.2 Calibration

G-TEK spent a total of 2 hours and 40 minutes in the calibration lanes, of which 1 hour and 40 minutes was spent collecting data.

3.4.3 Downtime Occasions

Occasions of downtime are grouped into five categories: equipment/data checks or equipment maintenance, equipment failure and repair, weather, Demonstration Site issues, or breaks/lunch. All downtime is included for the purposes of calculating labor costs (section 5) except for downtime due to Demonstration Site issues. Demonstration Site issues, while noted in the Daily Log, are considered non-chargeable downtime for the purposes of calculating labor costs and are not discussed. Breaks and lunches are discussed in this section and billed to the total Site Survey area.

3.4.3.1 Equipment/data checks, maintenance. Equipment data checks and maintenance activities accounted for 25 minutes of site usage time. These activities included changing out batteries and routine data checks to ensure the data was being properly recorded/collected. G-TEK spent an additional 1 hour and 25 minutes for breaks and lunches.

3.4.3.2 Equipment failure or repair. No time was needed to resolve equipment failures that occurred while surveying the Blind Grid.

3.4.3.3 Weather. No weather delays occurred during the survey.

3.4.4 Data Collection

G-TEK spent a total time of 3 hours and 55 minutes in the Blind Grid area, 1 hour and 35 minutes of which was spent collecting data.

3.4.5 Demobilization

The G-TEK survey crew went on to conduct a full demonstration of the site. Therefore, demobilization did not occur until 4 June 2004. On that day, it took the crew 3 hours and 30 minutes to break down and pack up their equipment.

3.5 PROCESSING TIME

G-TEK submitted the raw data from the demonstration activities on the last day of the demonstration, as required. The scoring submittal data was also provided within the required 30-day timeframe.

3.6 DEMONSTRATOR'S FIELD SURVEYING METHOD

G-TEK surveyed the Blind Grid by surrounding it with a 30 by 30 meter cable. Due to the size of the Blind Grid, it took two setups for G-TEK. They started in the southeast corner of the Blind Grid and surveyed in a north/south direction.

3.7 SUMMARY OF DAILY LOGS

Daily logs capture all field activities during this demonstration and are located in Appendix D. Activities pertinent to this specific demonstration are indicated in highlighted text.

SECTION 4. TECHNICAL PERFORMANCE RESULTS

4.1 ROC CURVES USING ALL ORDNANCE CATEGORIES

Figure 2, 4, and 6 shows the probability of detection for the response stage (P_d^{res}) and the discrimination stage (P_d^{disc}) versus their respective probability of false positive for the EM sensor(s), MAG sensor(s) and combined EM/MAG picks respectively. Figure 3, 5, and 7 shows both probabilities plotted against their respective probability of background alarm. Both figures use horizontal lines to illustrate the performance of the demonstrator at two demonstrator-specified points: at the system noise level for the response stage, representing the point below which targets are not considered detectable, and at the demonstrator's recommended threshold level for the discrimination stage, defining the subset of targets the demonstrator would recommend digging based on discrimination. Note that all points have been rounded to protect the ground truth.

The overall ground truth is composed of ferrous and non-ferrous anomalies. Due to limitations of the magnetometer, the non-ferrous items cannot be detected. Therefore, the ROC curves presented in figures 4 and 5 of this section are based on the subset of the ground truth that is solely made up of ferrous anomalies.

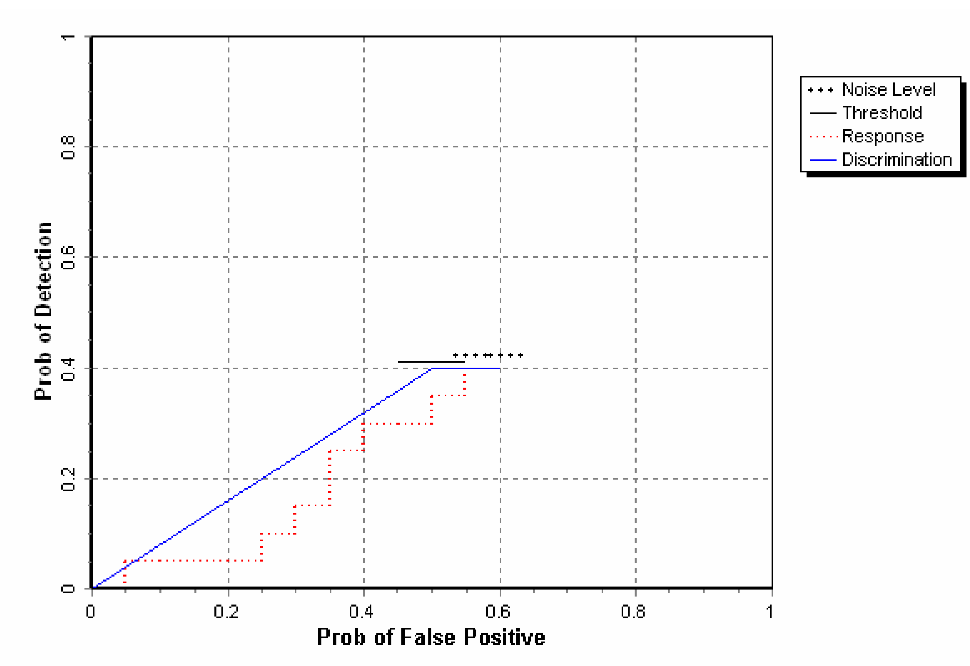

Figure 2. EM SENSOR Blind Grid probability of detection for response and discrimination stages versus their respective probability of false positive over all ordnance categories combined.

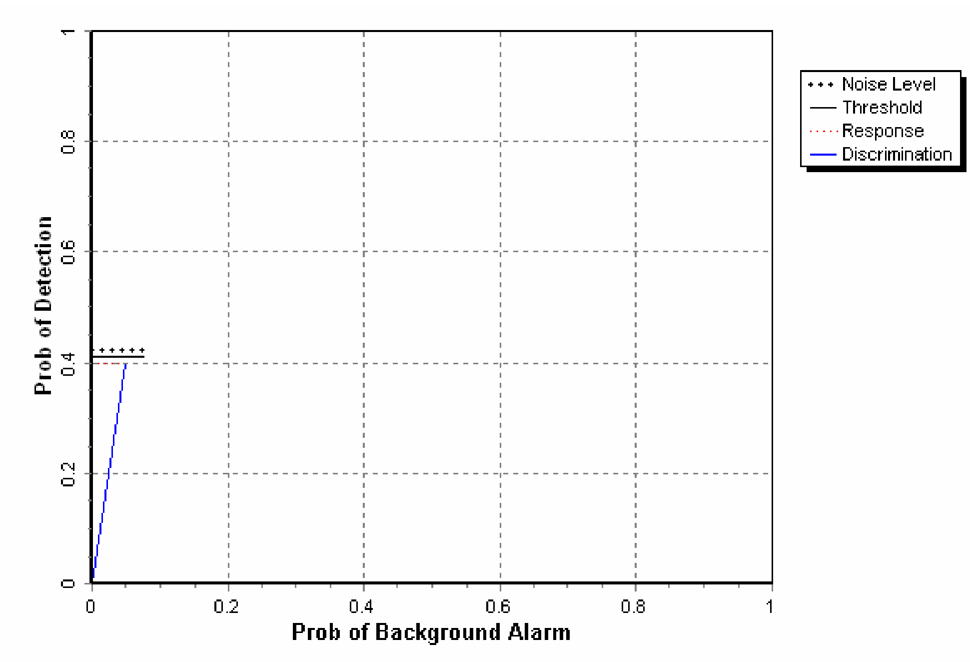

Figure 3. EM Sensor Blind Grid probability of detection for response and discrimination stages versus their respective probability of background alarm over all ordnance categories combined.

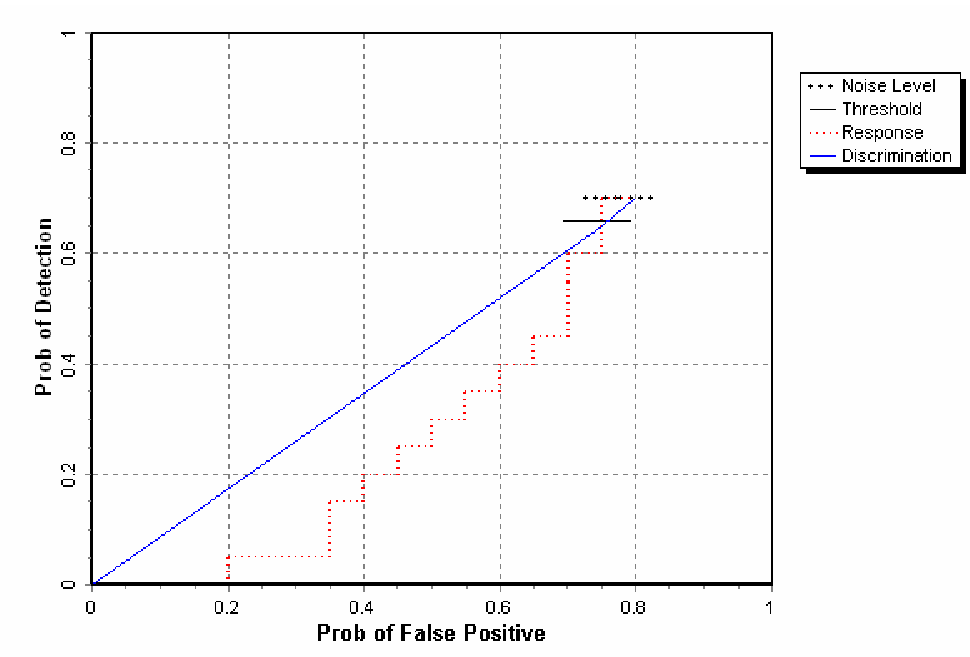

Figure 4. MAG Sensor Blind Grid probability of detection for response and discrimination stages versus their respective probability of false positive over all ordnance categories combined.

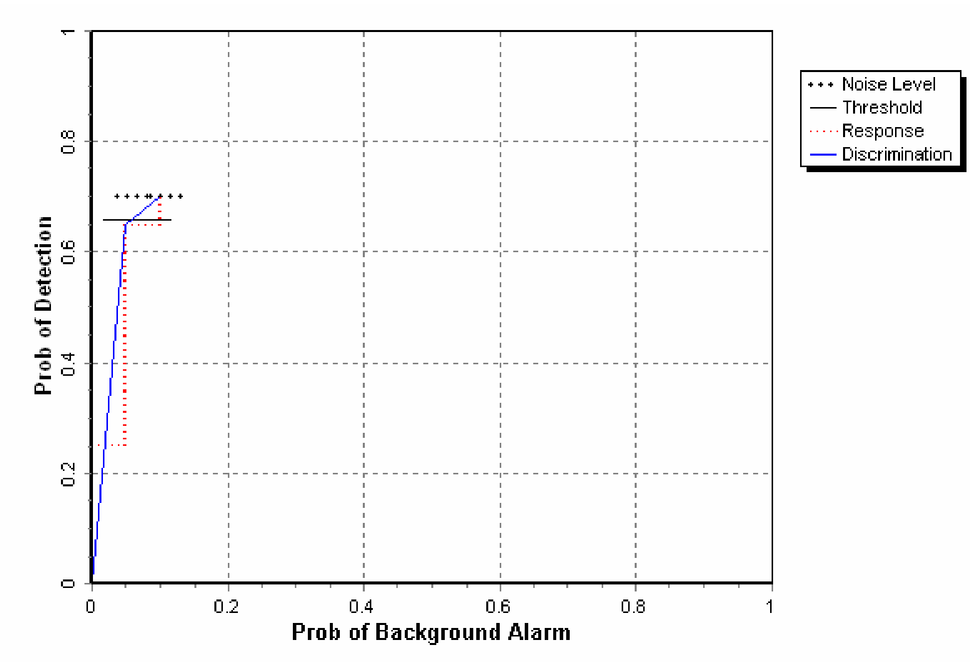

Figure 5. MAG Sensor Blind Grid probability of detection for response and discrimination stages versus their respective probability of background alarm over all ordnance categories combined.

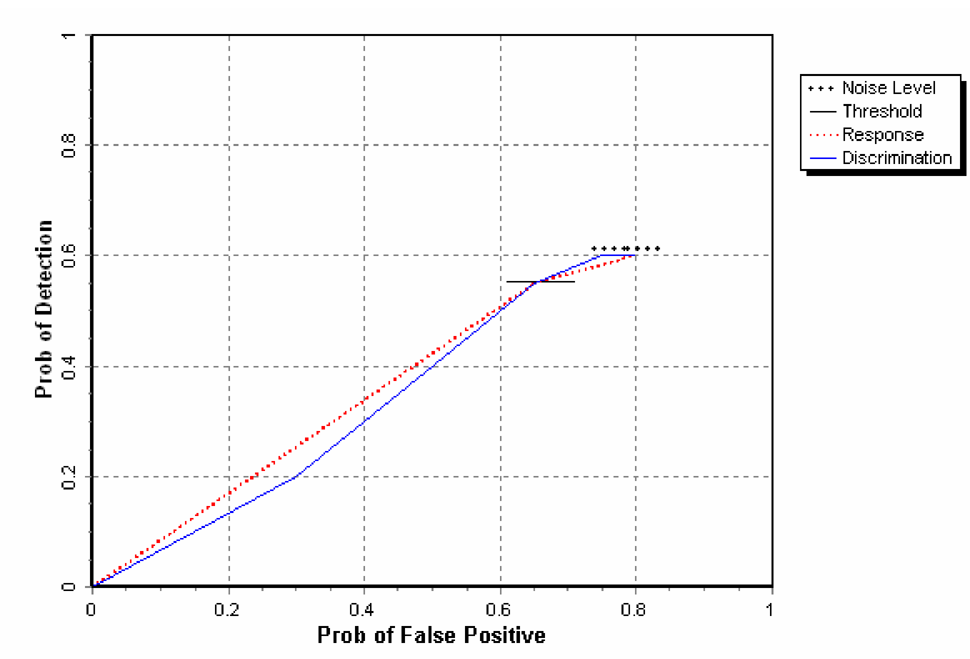

Figure 6. Combined Sensor Blind Grid probability of detection for response and discrimination stages versus their respective probability of false positive over all ordnance categories combined.

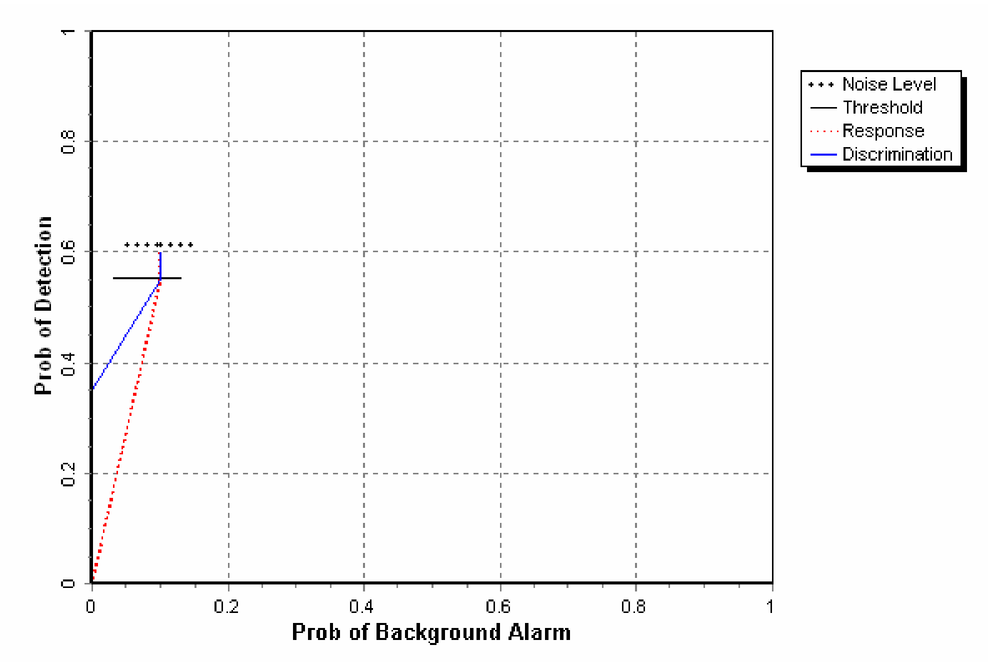

Figure 7. Combined Sensor Blind Grid probability of detection for response and discrimination stages versus their respective probability of background alarm over all ordnance categories combined.

4.2 ROC CURVES USING ORDNANCE LARGER THAN 20 MM

Figure 8, 10, and 12 shows the probability of detection for the response stage (P_d^{res}) and the discrimination stage (P_d^{disc}) versus their respective probability of false positive when only targets larger than 20 mm are scored for the EM sensor(s), MAG sensor(s) and Combined EM/MAG picks respectively. Figure 9, 11, and 13 shows both probabilities plotted against their respective probability of background alarm. Both figures use horizontal lines to illustrate the performance of the demonstrator at two demonstrator-specified points: at the system noise level for the response stage, representing the point below which targets are not considered detectable, and at the demonstrator's recommended threshold level for the discrimination stage, defining the subset of targets the demonstrator would recommend digging based on discrimination. Note that all points have been rounded to protect the ground truth.

The overall ground truth is composed of ferrous and non-ferrous anomalies. Due to limitations of the magnetometer, the non-ferrous items cannot be detected. Therefore, the ROC curves presented in figures 10 and 11 of this section are based on the subset of the ground truth that is solely made up of ferrous anomalies.

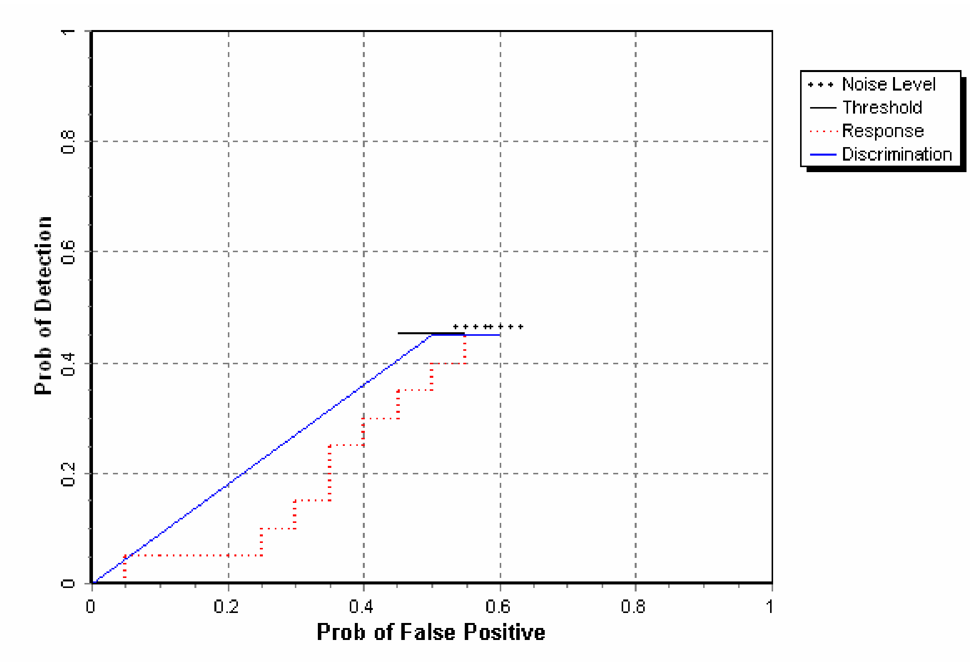

Figure 8. EM Sensor Blind Grid probability of detection for response and discrimination stages versus their respective probability of false positive for all ordnance larger than 20 mm.

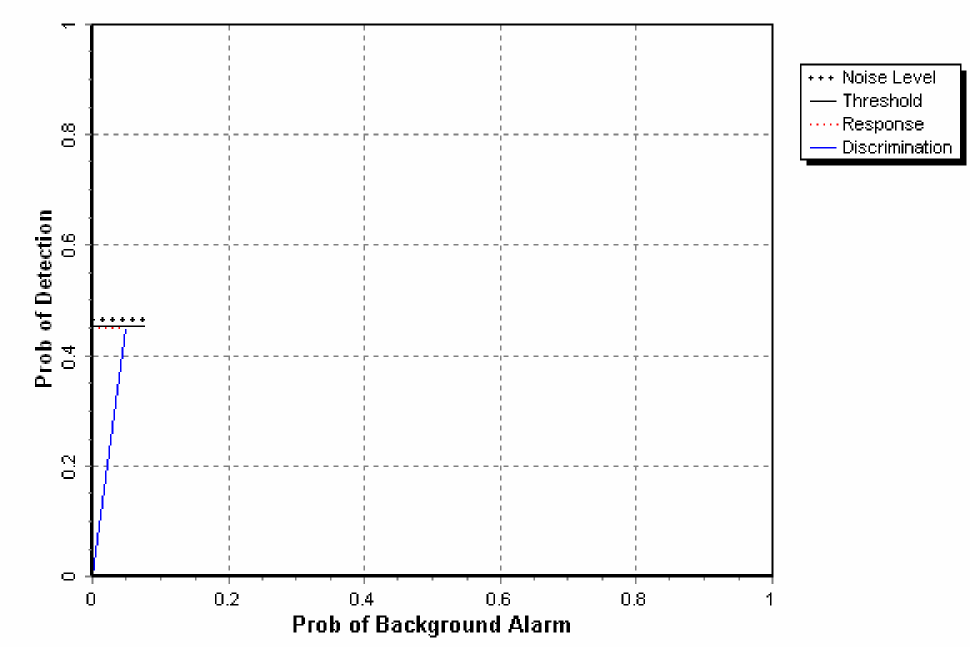

Figure 9. EM Sensor Blind Grid probability of detection for response and discrimination stages versus their respective probabilities of background alarm for all ordnance larger than 20 mm.

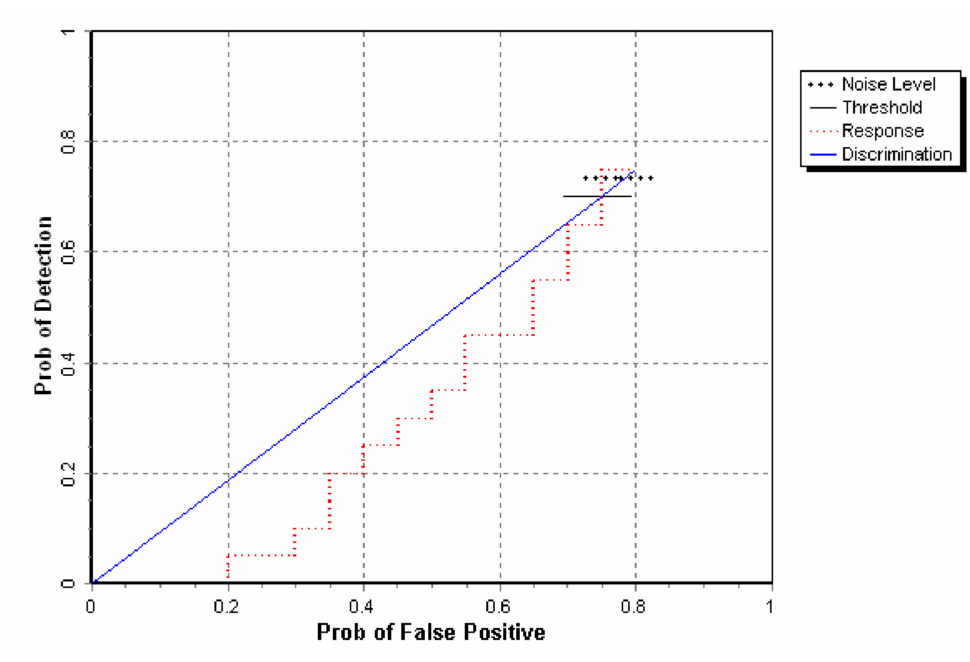

Figure 10. MAG Sensor Blind Grid probability of detection for response and discrimination stages versus their respective probability of false positive for all ordnance larger than 20 mm.

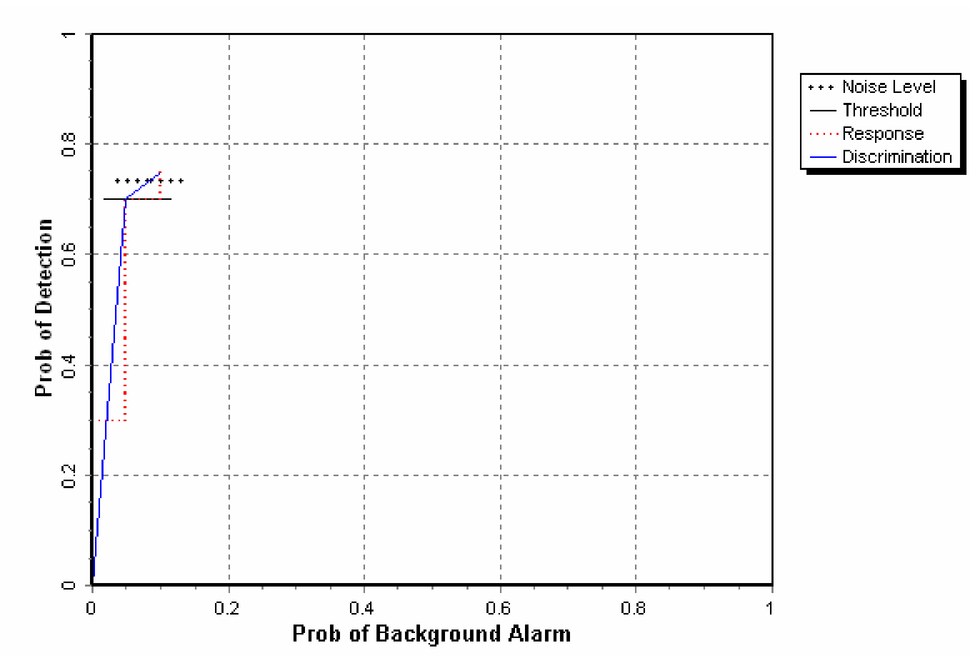

Figure 11. MAG Sensor Blind Grid probability of detection for response and discrimination stages versus their respective probabilities of background alarm for all ordnance larger than 20 mm.

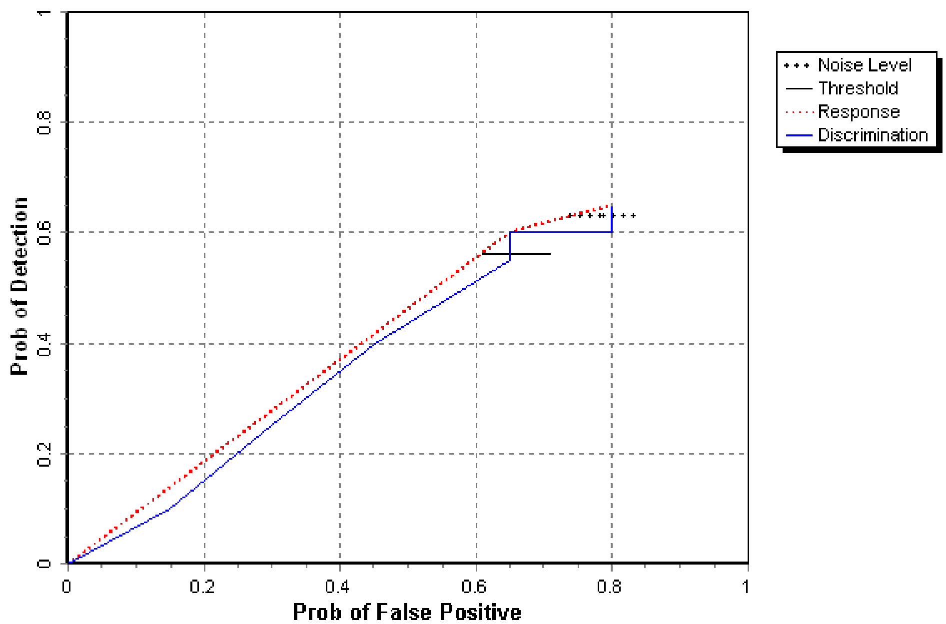

Figure 12. Combined Sensor Blind Grid probability of detection for response and discrimination stages versus their respective probability of false positive for all ordnance larger than 20 mm.

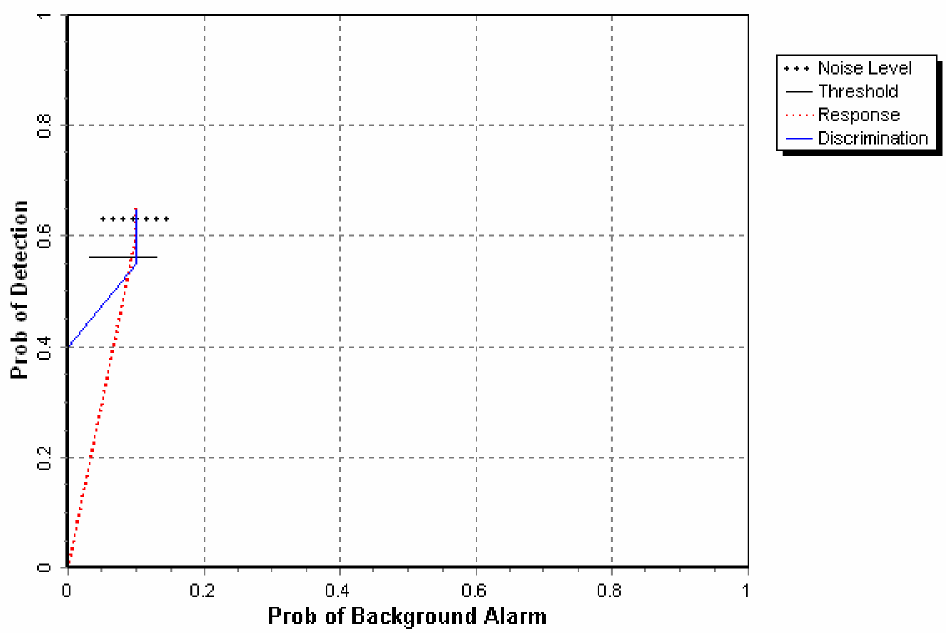

Figure 13. Combined Sensor Blind Grid probability of detection for response and discrimination stages versus their respective probabilities of background alarm for all ordnance larger than 20 mm.

4.3 PERFORMANCE SUMMARIES

Results for the Blind Grid test broken out by sensor type, size, depth and nonstandard ordnance are presented in Tables 5a, b, and c (for cost results, see section 5). Results by size and depth include both standard and nonstandard ordnance. The results by size show how well the demonstrator did at detecting/discriminating ordnance of a certain caliber range (see app A for size definitions). The results are relative to the number of ordnance items emplaced.

The RESPONSE STAGE results are derived from the list of anomalies above the demonstrator-provided noise level. The results for the DISCRIMINATION STAGE are derived from the demonstrator's recommended threshold for optimizing UXO field cleanup by minimizing false digs and maximizing ordnance recovery. The lower 90 percent confidence limit on probability of detection and P_{fp} was calculated assuming that the number of detections and false positives are binomially distributed random variables. All results in Table 5 have been rounded to protect the ground truth. However, lower confidence limits were calculated using actual results.

The overall ground truth is composed of ferrous and nonferrous anomalies. Due to limitations of the magnetometer, the non-ferrous items cannot be detected. Therefore, the summary presented in Table 5b is split exhibiting results based on the subset of the ground truth that is solely the ferrous anomalies and the full ground truth for comparison purposes.

All other tables presented in this section are based on scoring against the ferrous only ground truth. The response stage noise level and recommended discrimination stage threshold values are provided by the demonstrator.

TABLE 5a. SUMMARY OF BLIND GRID RESULTS FOR THE SAM/SLING (EM SENSOR)

Metric	Overall	Standard	Nonstandard	By Size			By Depth, m		
				Small	Medium	Large	< 0.3	0.3 to <1	>= 1
RESPONSE STAGE									
P_d	0.40	0.50	0.30	0.25	0.50	0.80	0.40	0.60	0.20
P_d Low 90% Conf	0.35	0.41	0.18	0.17	0.39	0.55	0.27	0.45	0.08
P_d Upper 90% Conf	0.50	0.61	0.41	0.37	0.64	0.95	0.49	0.71	0.42
P_{fp}	0.60	-	-	-	-	-	0.60	0.55	0.80
P_{fp} Low 90% Conf	0.51	-	-	-	-	-	0.49	0.44	0.42
P_d Upper 90% Conf	0.65	-	-	-	-	-	0.69	0.65	0.98
P_{ba}	0.05	-	-	-	-	-	-	-	-
DISCRIMINATION STAGE									
P_d	0.40	0.50	0.30	0.25	0.50	0.80	0.40	0.55	0.20
P_d Low 90% Conf	0.34	0.39	0.18	0.17	0.36	0.55	0.27	0.42	0.08
P_d Upper 90% Conf	0.49	0.59	0.41	0.37	0.61	0.95	0.49	0.68	0.42
P_{fp}	0.50	-	-	-	-	-	0.50	0.50	0.60
P_{fp} Low 90% Conf	0.43	-	-	-	-	-	0.39	0.39	0.25
P_d Upper 90% Conf	0.57	-	-	-	-	-	0.59	0.61	0.89
P_{ba}	0.05	-	-	-	-	-	-	-	-

Response Stage Noise Level: 1.65
Recommended Discrimination Stage Threshold: 0.75

TABLE 5b. SUMMARY OF BLIND GRID RESULTS FOR THE SAM/SLING (MAG SENSOR)

FERROUS ONLY GROUND TRUTH									
				By Size			By Depth, m		
Metric	**Overall**	**Standard**	**Nonstandard**	**Small**	**Medium**	**Large**	**< 0.3**	**0.3 to <1**	**>= 1**
RESPONSE STAGE									
P_d	0.70	0.80	0.50	0.65	0.70	0.80	0.80	0.70	0.45
P_d Low 90% Conf	0.62	0.70	0.38	0.52	0.58	0.55	0.67	0.58	0.26
P_d Upper 90% Conf	0.77	0.88	0.66	0.77	0.82	0.95	0.89	0.83	0.67
P_{fp}	0.80	-	-	-	-	-	0.80	0.75	1.00
P_{fp} Low 90% Conf	0.71	-	-	-	-	-	0.69	0.63	0.63
P_{fp} Upper 90% Conf	0.83	-	-	-	-	-	0.86	0.83	1.00
P_{ba}	0.10	-	-	-	-	-	-	-	-
DISCRIMINATION STAGE									
P_d	0.65	0.80	0.45	0.60	0.65	0.80	0.70	0.70	0.40
P_d Low 90% Conf	0.57	0.68	0.30	0.48	0.51	0.55	0.59	0.58	0.02
P_d Upper 90% Conf	0.73	0.86	0.59	0.74	0.76	0.95	0.83	0.83	0.60
P_{fp}	0.75	-	-	-	-	-	0.75	0.70	1.00
P_{fp} Low 90% Conf	0.68	-	-	-	-	-	0.65	0.61	0.63
P_{fp} Upper 90% Conf	0.80	-	-	-	-	-	0.83	0.81	1.00
P_{ba}	0.05	-	-	-	-	-	-	-	-

FULL GROUND TRUTH									
				By Size			By Depth, m		
Metric	**Overall**	**Standard**	**Nonstandard**	**Small**	**Medium**	**Large**	**< 0.3**	**0.3 to <1**	**>= 1**
RESPONSE STAGE									
P_d	0.60	0.70	0.40	0.45	0.70	0.80	0.55	0.70	0.45
P_d Low 90% Conf	0.51	0.61	0.29	0.35	0.58	0.55	0.46	0.55	0.24
P_d Upper 90% Conf	0.66	0.79	0.53	0.56	0.82	0.95	0.68	0.80	0.63
P_{fp}	0.80	-	-	-	-	-	0.80	0.75	1.00
P_{fp} Low 90% Conf	0.71	-	-	-	-	-	0.69	0.63	0.63
P_{fp} Upper 90% Conf	0.83	-	-	-	-	-	0.86	0.83	1.00
P_{ba}	0.10	-	-	-	-	-	-	-	-
DISCRIMINATION STAGE									
P_d	0.55	0.70	0.35	0.45	0.65	0.80	0.55	0.70	0.35
P_d Low 90% Conf	0.48	0.59	0.23	0.32	0.51	0.55	0.41	0.55	0.19
P_d Upper 90% Conf	0.63	0.77	0.47	0.54	0.76	0.95	0.64	0.80	0.56
P_{fp}	0.75	-	-	-	-	-	0.75	0.70	1.00
P_{fp} Low 90% Conf	0.68	-	-	-	-	-	0.65	0.61	0.63
P_{fp} Upper 90% Conf	0.80	-	-	-	-	-	0.83	0.81	1.00
P_{ba}	0.05	-	-	-	-	-	-	-	-

Response Stage Noise Level: 2.05
Recommended Discrimination Stage Threshold: 0.70

TABLE 5c. SUMMARY OF BLIND GRID RESULTS FOR THE SAM/SLING (COMBINED EM/MAG RESULTS)

Metric	Overall	Standard	Nonstandard	By Size			By Depth, m		
				Small	Medium	Large	< 0.3	0.3 to <1	>= 1
RESPONSE STAGE									
P_d	0.60	0.75	0.45	0.50	0.70	0.80	0.65	0.70	0.45
P_d Low 90% Conf	0.54	0.63	0.32	0.39	0.58	0.55	0.51	0.55	0.24
P_d Upper 90% Conf	0.69	0.81	0.57	0.61	0.82	0.95	0.73	0.80	0.63
P_{fp}	0.80	-	-	-	-	-	0.80	0.75	1.00
P_{fp} Low 90% Conf	0.72	-	-	-	-	-	0.71	0.63	0.63
P_{fp} Upper 90% Conf	0.84	-	-	-	-	-	0.88	0.83	1.00
P_{ba}	0.10	-	-	-	-	-	-	-	-
DISCRIMINATION STAGE									
P_d	0.55	0.70	0.35	0.50	0.60	0.80	0.55	0.65	0.35
P_d Low 90% Conf	0.48	0.59	0.23	0.37	0.45	0.55	0.44	0.52	0.19
P_d Upper 90% Conf	0.63	0.77	0.47	0.59	0.70	0.95	0.66	0.77	0.56
P_{fp}	0.65	-	-	-	-	-	0.65	0.65	0.80
P_{fp} Low 90% Conf	0.59	-	-	-	-	-	0.56	0.53	0.42
P_{fp} Upper 90% Conf	0.72	-	-	-	-	-	0.75	0.74	0.98
P_{ba}	0.10	-	-	-	-	-	-	-	-

Response Stage Noise Level: 0.04
Recommended Discrimination Stage Threshold: 4.90

Note: The recommended discrimination stage threshold values are provided by the demonstrator.

4.4 EFFICIENCY, REJECTION RATES, AND TYPE CLASSIFICATION (All results based on Combined EM/MAG data set)

Efficiency and rejection rates are calculated to quantify the discrimination ability at specific points of interest on the ROC curve: (1) at the point where no decrease in P_d is suffered (i.e., the efficiency is by definition equal to one) and (2) at the operator selected threshold. These values are reported in Table 6.

TABLE 6. EFFICIENCY AND REJECTION RATES

	Efficiency (E)	False Positive Rejection Rate	Background Alarm Rejection Rate
At Operating Point	0.90	0.16	0.19
With No Loss of P_d	1.00	0.00	0.00

At the demonstrator's recommended setting, the ordnance items that were detected and correctly discriminated were further scored on whether their correct type could be identified (table 7). Correct type examples include "20-mm projectile, 105-mm HEAT Projectile, and 2.75-inch Rocket". A list of the standard type declaration required for each ordnance item was provided to demonstrators prior to testing. For example, the standard type for the three example items are 20mmP, 105H, and 2.75in, respectively.

TABLE 7. CORRECT TYPE CLASSIFICATION OF TARGETS CORRECTLY DISCRIMINATED AS UXO

Size	Percentage Correct
Small	25.0
Medium	11.0
Large	25.0
Overall	19.6

4.5 LOCATION ACCURACY

The mean location error and standard deviations appear in Table 8. These calculations are based on average missed depth for ordnance correctly identified in the discrimination stage. Depths are measured from the closest point of the ordnance to the surface. For the Blind Grid, only depth errors are calculated, since (X, Y) positions are known to be the centers of each grid square.

TABLE 8. MEAN LOCATION ERROR AND STANDARD DEVIATION (M)

	Mean	Standard Deviation
Depth	-0.15	0.24

SECTION 5. ON-SITE LABOR COSTS

A standardized estimate for labor costs associated with this effort was calculated as follows: the first person at the test site was designated “supervisor”, the second person was designated “data analyst”, and the third and following personnel were considered “field support”. Standardized hourly labor rates were charged by title: supervisor at $95.00/hour, data analyst at $57.00/hour, and field support at $28.50/hour.

Government representatives monitored on-site activity. All on-site activities were grouped into one of ten categories: initial setup/mobilization, daily setup/stop, calibration, collecting data, downtime due to break/lunch, downtime due to equipment failure, downtime due to equipment/data checks or maintenance, downtime due to weather, downtime due to demonstration site issue, or demobilization. See Appendix D for the daily activity log. See section 3.4 for a summary of field activities.

The standardized cost estimate associated with the labor needed to perform the field activities is presented in Table 9. Note that calibration time includes time spent in the Calibration Lanes as well as field calibrations. “Site survey time” includes daily setup/stop time, collecting data, breaks/lunch, downtime due to equipment/data checks or maintenance, downtime due to failure, and downtime due to weather.

TABLE 9. ON-SITE LABOR COSTS

	No. People	Hourly Wage	Hours	Cost
Initial Setup				
Supervisor	1	$95.00	5.0	$475.00
Data Analyst	1	57.00	5.0	285.00
Field Support	2	28.50	5.0	285.00
SubTotal				**$1,045.00**
Calibration				
Supervisor	1	$95.00	2.66	$252.70
Data Analyst	1	57.00	2.66	151.62
Field Support	2	28.50	2.66	151.62
SubTotal				**$555.94**
Site Survey				
Supervisor	1	$95.00	3.92	$372.40
Data Analyst	1	57.00	3.92	223.44
Field Support	2	28.50	3.92	223.44
SubTotal				**$819.28**

See notes at end of table.

TABLE 9 (CONT'D)

	No. People	Hourly Wage	Hours	Cost
Demobilization				
Supervisor	1	$95.00	3.50	$332.50
Data Analyst	1	57.00	3.50	199.50
Field Support	2	28.50	3.50	199.50
Subtotal				**$731.50**
Total				**$3,151.72**

Notes: Calibration time includes time spent in the Calibration Lanes as well as calibration before each data run.

Site Survey time includes daily setup/stop time, collecting data, breaks/lunch, downtime due to system maintenance, failure, and weather.

SECTION 6. COMPARISON OF RESULTS TO DATE

No comparisons to date.

SECTION 7. APPENDIXES

APPENDIX A. TERMS AND DEFINITIONS

GENERAL DEFINITIONS

Anomaly: Location of a system response deemed to warrant further investigation by the demonstrator for consideration as an emplaced ordnance item.

Detection: An anomaly location that is within R_{halo} of an emplaced ordnance item.

Emplaced Ordnance: An ordnance item buried by the government at a specified location in the test site.

Emplaced Clutter: A clutter item (i.e., non-ordnance item) buried by the government at a specified location in the test site.

R_{halo}: A pre-determined radius about the periphery of an emplaced item (clutter or ordnance) within which a location identified by the demonstrator as being of interest is considered to be a response from that item. If multiple declarations lie within R_{halo} of any item (clutter or ordnance), the declaration with the highest signal output within the R_{halo} will be utilized. For the purpose of this program, a circular halo 0.5 meters in radius will be placed around the center of the object for all clutter and ordnance items less than 0.6 meters in length. When ordnance items are longer than 0.6 meters, the halo becomes an ellipse where the minor axis remains 1 meter and the major axis is equal to the length of the ordnance plus 1 meter.

Small Ordnance: Caliber of ordnance less than or equal to 40 mm (includes 20-mm projectile, 40-mm projectile, submunitions BLU-26, BLU-63, and M42).

Medium Ordnance: Caliber of ordnance greater than 40 mm and less than or equal to 81 mm (includes 57-mm projectile, 60-mm mortar, 2.75 in. Rocket, MK118 Rockeye, 81-mm mortar).

Large Ordnance: Caliber of ordnance greater than 81 mm (includes 105-mm HEAT, 105-mm projectile, 155-mm projectile, 500-pound bomb).

Shallow: Items buried less than 0.3 meter below ground surface.

Medium: Items buried greater than or equal to 0.3 meter and less than 1 meter below ground surface.

Deep: Items buried greater than or equal to 1 meter below ground surface.

Response Stage Noise Level: The level that represents the point below which anomalies are not considered detectable. Demonstrators are required to provide the recommended noise level for the Blind Grid test area.

Discrimination Stage Threshold: The demonstrator selected threshold level that they believe provides optimum performance of the system by retaining all detectable ordnance and rejecting the maximum amount of clutter. This level defines the subset of anomalies the demonstrator would recommend digging based on discrimination.

Binomially Distributed Random Variable: A random variable of the type which has only two possible outcomes, say success and failure, is repeated for n independent trials with the probability p of success and the probability 1-p of failure being the same for each trial. The number of successes x observed in the n trials is an estimate of p and is considered to be a binomially distributed random variable.

RESPONSE AND DISCRIMINATION STAGE DATA

The scoring of the demonstrator's performance is conducted in two stages. These two stages are termed the RESPONSE STAGE and DISCRIMINATION STAGE. For both stages, the probability of detection (P_d) and the false alarms are reported as receiver operating characteristic (ROC) curves. False alarms are divided into those anomalies that correspond to emplaced clutter items, measuring the probability of false positive (P_{fp}) and those that do not correspond to any known item, termed background alarms.

The RESPONSE STAGE scoring evaluates the ability of the system to detect emplaced targets without regard to ability to discriminate ordnance from other anomalies. For the RESPONSE STAGE, the demonstrator provides the scoring committee with the location and signal strength of all anomalies that the demonstrator has deemed sufficient to warrant further investigation and/or processing as potential emplaced ordnance items. This list is generated with minimal processing (e.g., this list will include all signals above the system noise threshold). As such, it represents the most inclusive list of anomalies.

The DISCRIMINATION STAGE evaluates the demonstrator's ability to correctly identify ordnance as such, and to reject clutter. For the same locations as in the RESPONSE STAGE anomaly list, the DISCRIMINATION STAGE list contains the output of the algorithms applied in the discrimination-stage processing. This list is prioritized based on the demonstrator's determination that an anomaly location is likely to contain ordnance. Thus, higher output values are indicative of higher confidence that an ordnance item is present at the specified location. For electronic signal processing, priority ranking is based on algorithm output. For other systems, priority ranking is based on human judgment. The demonstrator also selects the threshold that the demonstrator believes will provide "optimum" system performance, (i.e., that retains all the detected ordnance and rejects the maximum amount of clutter).

Note: The two lists provided by the demonstrator contain identical numbers of potential target locations. They differ only in the priority ranking of the declarations.

RESPONSE STAGE DEFINITIONS

Response Stage Probability of Detection (P_d^{res}): P_d^{res} = (No. of response-stage detections)/(No. of emplaced ordnance in the test site).

Response Stage False Positive (fp^{res}): An anomaly location that is within R_{halo} of an emplaced clutter item.

Response Stage Probability of False Positive (P_{fp}^{res}): P_{fp}^{res} = (No. of response-stage false positives)/(No. of emplaced clutter items).

Response Stage Background Alarm (ba^{res}): An anomaly in a blind grid cell that contains neither emplaced ordnance nor an emplaced clutter item. An anomaly location in the open field or scenarios that is outside R_{halo} of any emplaced ordnance or emplaced clutter item.

Response Stage Probability of Background Alarm (P_{ba}^{res}): Blind Grid only: P_{ba}^{res} = (No. of response-stage background alarms)/(No. of empty grid locations).

Response Stage Background Alarm Rate (BAR^{res}): Open Field only: BAR^{res} = (No. of response-stage background alarms)/(arbitrary constant).

Note that the quantities P_d^{res}, P_{fp}^{res}, P_{ba}^{res}, and BAR^{res} are functions of t^{res}, the threshold applied to the response-stage signal strength. These quantities can therefore be written as $P_d^{res}(t^{res})$, $P_{fp}^{res}(t^{res})$, $P_{ba}^{res}(t^{res})$, and $BAR^{res}(t^{res})$.

DISCRIMINATION STAGE DEFINITIONS

Discrimination: The application of a signal processing algorithm or human judgment to response-stage data that discriminates ordnance from clutter. Discrimination should identify anomalies that the demonstrator has high confidence correspond to ordnance, as well as those that the demonstrator has high confidence correspond to non-ordnance or background returns. The former should be ranked with highest priority and the latter with lowest.

Discrimination Stage Probability of Detection (P_d^{disc}): P_d^{disc} = (No. of discrimination-stage detections)/(No. of emplaced ordnance in the test site).

Discrimination Stage False Positive (fp^{disc}): An anomaly location that is within R_{halo} of an emplaced clutter item.

Discrimination Stage Probability of False Positive (P_{fp}^{disc}): P_{fp}^{disc} = (No. of discrimination stage false positives)/(No. of emplaced clutter items).

Discrimination Stage Background Alarm (ba^{disc}): An anomaly in a blind grid cell that contains neither emplaced ordnance nor an emplaced clutter item. An anomaly location in the open field or scenarios that is outside R_{halo} of any emplaced ordnance or emplaced clutter item.

Discrimination Stage Probability of Background Alarm (P_{ba}^{disc}): P_{ba}^{disc} = (No. of discrimination-stage background alarms)/(No. of empty grid locations).

Discrimination Stage Background Alarm Rate (BAR^{disc}): BAR^{disc} = (No. of discrimination-stage background alarms)/(arbitrary constant).

Note that the quantities P_d^{disc}, P_{fp}^{disc}, P_{ba}^{disc}, and BAR^{disc} are functions of t^{disc}, the threshold applied to the discrimination-stage signal strength. These quantities can therefore be written as $P_d^{disc}(t^{disc})$, $P_{fp}^{disc}(t^{disc})$, $P_{ba}^{disc}(t^{disc})$, and $BAR^{disc}(t^{disc})$.

RECEIVER-OPERATING CHARACERISTIC (ROC) CURVES

ROC curves at both the response and discrimination stages can be constructed based on the above definitions. The ROC curves plot the relationship between P_d versus P_{fp} and P_d versus BAR or P_{ba} as the threshold applied to the signal strength is varied from its minimum (t_{min}) to its maximum (t_{max}) value.[1] Figure A-1 shows how P_d versus P_{fp} and P_d versus BAR are combined into ROC curves. Note that the "res" and "disc" superscripts have been suppressed from all the variables for clarity.

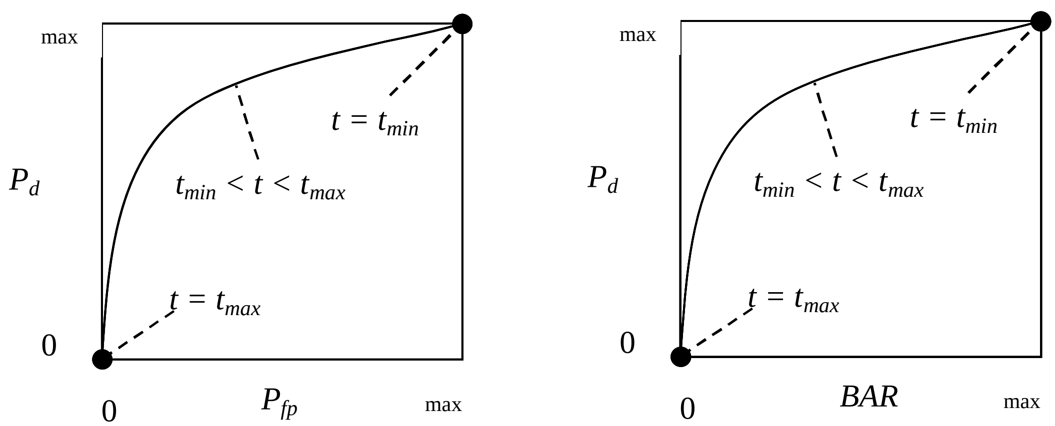

Figure A-1. ROC curves for open field testing. Each curve applies to both the response and discrimination stages.

[1]Strictly speaking, ROC curves plot the P_d versus P_{ba} over a pre-determined and fixed number of detection opportunities (some of the opportunities are located over ordnance and others are located over clutter or blank spots). In an open field scenario, each system suppresses its signal strength reports until some bare-minimum signal response is received by the system. Consequently, the open field ROC curves do not have information from low signal-output locations, and, furthermore, different contractors report their signals over a different set of locations on the ground. These ROC curves are thus not true to the strict definition of ROC curves as defined in textbooks on detection theory. Note, however, that the ROC curves obtained in the Blind Grid test sites are true ROC curves.

METRICS TO CHARACTERIZE THE DISCRIMINATION STAGE

The demonstrator is also scored on efficiency and rejection ratio, which measure the effectiveness of the discrimination stage processing. The goal of discrimination is to retain the greatest number of ordnance detections from the anomaly list, while rejecting the maximum number of anomalies arising from non-ordnance items. The efficiency measures the amount of detected ordnance retained by the discrimination, while the rejection ratio measures the fraction of false alarms rejected. Both measures are defined relative to the entire response list, i.e., the maximum ordnance detectable by the sensor and its accompanying false positive rate or background alarm rate.

Efficiency (E): $E = P_d^{disc}(t^{disc})/P_d^{res}(t_{min}^{res})$; Measures (at a threshold of interest), the degree to which the maximum theoretical detection performance of the sensor system (as determined by the response stage tmin) is preserved after application of discrimination techniques. Efficiency is a number between 0 and 1. An efficiency of 1 implies that all of the ordnance initially detected in the response stage was retained at the specified threshold in the discrimination stage, t^{disc}.

False Positive Rejection Rate (R_{fp}): $R_{fp} = 1 - [P_{fp}^{disc}(t^{disc})/P_{fp}^{res}(t_{min}^{res})]$; Measures (at a threshold of interest), the degree to which the sensor system's false positive performance is improved over the maximum false positive performance (as determined by the response stage tmin). The rejection rate is a number between 0 and 1. A rejection rate of 1 implies that all emplaced clutter initially detected in the response stage were correctly rejected at the specified threshold in the discrimination stage.

Background Alarm Rejection Rate (R_{ba}):

Blind Grid: $R_{ba} = 1 - [P_{ba}^{disc}(t^{disc})/P_{ba}^{res}(t_{min}^{res})]$.
Open Field: $R_{ba} = 1 - [BAR^{disc}(t^{disc})/BAR^{res}(t_{min}^{res})]$).

Measures the degree to which the discrimination stage correctly rejects background alarms initially detected in the response stage. The rejection rate is a number between 0 and 1. A rejection rate of 1 implies that all background alarms initially detected in the response stage were rejected at the specified threshold in the discrimination stage.

CHI-SQUARE COMPARISON EXPLANATION:

The Chi-square test for differences in probabilities (or 2 x 2 contingency table) is used to analyze two samples drawn from two different populations to see if both populations have the same or different proportions of elements in a certain category. More specifically, two random samples are drawn, one from each population, to test the null hypothesis that the probability of event A (some specified event) is the same for both populations (ref 3).

A 2 x 2 contingency table is used in the Standardized UXO Technology Demonstration Site Program to determine if there is reason to believe that the proportion of ordnance correctly detected/discriminated by demonstrator X’s system is significantly degraded by the more challenging terrain feature introduced. The test statistic of the 2 x 2 contingency table is the

Chi-square distribution with one degree of freedom. Since an association between the more challenging terrain feature and relatively degraded performance is sought, a one-sided test is performed. A significance level of 0.05 is chosen which sets a critical decision limit of 2.71 from the Chi-square distribution with one degree of freedom. It is a critical decision limit because if the test statistic calculated from the data exceeds this value, the two proportions tested will be considered significantly different. If the test statistic calculated from the data is less than this value, the two proportions tested will be considered not significantly different.

An exception must be applied when either a 0 or 100 percent success rate occurs in the sample data. The Chi-square test cannot be used in these instances. Instead, Fischer's test is used and the critical decision limit for one-sided tests is the chosen significance level, which in this case is 0.05. With Fischer's test, if the test statistic is less than the critical value, the proportions are considered to be significantly different.

Standardized UXO Technology Demonstration Site examples, where blind grid results are compared to those from the open field and open field results are compared to those from one of the scenarios, follow. It should be noted that a significant result does not prove a cause and effect relationship exists between the two populations of interest; however, it does serve as a tool to indicate that one data set has experienced a degradation in system performance at a large enough level than can be accounted for merely by chance or random variation. Note also that a result that is not significant indicates that there is not enough evidence to declare that anything more than chance or random variation within the same population is at work between the two data sets being compared.

Demonstrator X achieves the following overall results after surveying each of the three progressively more difficult areas using the same system (results indicate the number of ordnance detected divided by the number of ordnance emplaced):

	Blind Grid	Open Field	Moguls
P_d^{res}	100/100 = 1.0	8/10 = .80	20/33 = .61
P_d^{disc}	80/100 = 0.80	6/10 = .60	8/33 = .24

P_d^{res}: BLIND GRID versus OPEN FIELD. Using the example data above to compare probabilities of detection in the response stage, all 100 ordnance out of 100 emplaced ordnance items were detected in the blind grid while 8 ordnance out of 10 emplaced were detected in the open field. Fischer's test must be used since a 100 percent success rate occurs in the data. Fischer's test uses the four input values to calculate a test statistic of 0.0075 that is compared against the critical value of 0.05. Since the test statistic is less than the critical value, the smaller response stage detection rate (0.80) is considered to be significantly less at the 0.05 level of significance. While a significant result does not prove a cause and effect relationship exists between the change in survey area and degradation in performance, it does indicate that the detection ability of demonstrator X's system seems to have been degraded in the open field relative to results from the blind grid using the same system.

P_d^{disc}: BLIND GRID versus OPEN FIELD. Using the example data above to compare probabilities of detection in the discrimination stage, 80 out of 100 emplaced ordnance items were correctly discriminated as ordnance in blind grid testing while 6 ordnance out of 10 emplaced were correctly discriminated as such in open field-testing. Those four values are used to calculate a test statistic of 1.12. Since the test statistic is less than the critical value of 2.71, the two discrimination stage detection rates are considered to be not significantly different at the 0.05 level of significance.

P_d^{res}: OPEN FIELD versus MOGULS. Using the example data above to compare probabilities of detection in the response stage, 8 out of 10 and 20 out of 33 are used to calculate a test statistic of 0.56. Since the test statistic is less than the critical value of 2.71, the two response stage detection rates are considered to be not significantly different at the 0.05 level of significance.

P_d^{disc}: OPEN FIELD versus MOGULS. Using the example data above to compare probabilities of detection in the discrimination stage, 6 out of 10 and 8 out of 33 are used to calculate a test statistic of 2.98. Since the test statistic is greater than the critical value of 2.71, the smaller discrimination stage detection rate is considered to be significantly less at the 0.05 level of significance. While a significant result does not prove a cause and effect relationship exists between the change in survey area and degradation in performance, it does indicate that the ability of demonstrator X to correctly discriminate seems to have been degraded by the mogul terrain relative to results from the flat open field using the same system.

APPENDIX B. DAILY WEATHER LOGS

TABLE B-1. WEATHER LOG

Date	Time	Average Temperature, ˚F	Total Precip., (in.)
5/24/2004	07:00	76.3	0.00
5/24/2004	08:00	78.6	0.00
5/24/2004	09:00	80.3	0.00
5/24/2004	10:00	82.3	0.00
5/24/2004	11:00	83.9	0.00
5/24/2004	12:00	85.7	0.00
5/24/2004	13:00	86.4	0.00
5/24/2004	14:00	87.5	0.00
5/24/2004	15:00	87.4	0.00
5/24/2004	16:00	86.5	0.00
5/24/2004	17:00	86.3	0.00
5/25/2004	07:00	72.5	0.00
5/25/2004	08:00	74.5	0.00
5/25/2004	09:00	76.9	0.00
5/25/2004	10:00	78.8	0.00
5/25/2004	11:00	81.4	0.00
5/25/2004	12:00	83.2	0.00
5/25/2004	13:00	84.8	0.00
5/25/2004	14:00	84.0	0.00
5/25/2004	15:00	85.3	0.00
5/25/2004	16:00	85.4	0.00
5/25/2004	17:00	85.2	0.00
5/26/2004	07:00	68.9	0.00
5/26/2004	08:00	70.4	0.00
5/26/2004	09:00	73.3	0.00
5/26/2004	10:00	73.6	0.00
5/26/2004	11:00	74.6	0.00
5/26/2004	12:00	75.3	0.00
5/26/2004	13:00	84.4	0.00
5/26/2004	14:00	76.3	0.00
5/26/2004	15:00	77.1	0.00
5/26/2004	16:00	77.4	0.00
5/26/2004	17:00	77.8	0.00

TABLE B-1. (CONT'D)

Date	Time	Average Temperature, °F	Total Precip., (in.)
5/27/2004	07:00	67.1	0.00
5/27/2004	08:00	69.7	0.00
5/27/2004	09:00	71.7	0.00
5/27/2004	10:00	73.6	0.00
5/27/2004	11:00	76.2	0.00
5/27/2004	12:00	77.1	0.00
5/27/2004	13:00	77.5	0.00
5/27/2004	14:00	79.1	0.00
5/27/2004	15:00	80.4	0.00
5/27/2004	16:00	80.6	0.00
5/27/2004	17:00	79.4	0.00
5/28/2004	07:00	71.2	0.00
5/28/2004	08:00	72.2	0.00
5/28/2004	09:00	74.3	0.00
5/28/2004	10:00	75.0	0.00
5/28/2004	11:00	77.1	0.00
5/28/2004	12:00	78.3	0.00
5/28/2004	13:00	79.0	0.00
5/28/2004	14:00	78.9	0.00
5/28/2004	15:00	79.7	0.00
5/28/2004	16:00	78.0	0.00
5/28/2004	17:00	79.1	0.00
5/29/2004	07:00	59.5	0.00
5/29/2004	08:00	60.5	0.00
5/29/2004	09:00	61.6	0.00
5/29/2004	10:00	63.3	0.00
5/29/2004	11:00	65.0	0.00
5/29/2004	12:00	66.9	0.00
5/29/2004	13:00	68.6	0.00
5/29/2004	14:00	69.8	0.00
5/29/2004	15:00	70.8	0.00
5/29/2004	16:00	70.9	0.00
5/29/2004	17:00	70.8	0.00
5/30/2004	07:00	61.1	0.00
5/30/2004	08:00	64.3	0.00
5/30/2004	09:00	65.2	0.00
5/30/2004	10:00	67.2	0.00
5/30/2004	11:00	68.5	0.00
5/30/2004	12:00	70.4	0.00
5/30/2004	13:00	72.8	0.00
5/30/2004	14:00	72.7	0.00
5/30/2004	15:00	72.3	0.00
5/30/2004	16:00	71.7	0.00
5/30/2004	17:00	71.7	0.00

TABLE B-1. (CONT'D)

Date	Time	Average Temperature, °F	Total Precip., (in.)
5/31/2004	07:00	66.9	0.00
5/31/2004	08:00	66.9	0.00
5/31/2004	09:00	66.9	0.00
5/31/2004	10:00	66.7	0.00
5/31/2004	11:00	65.6	0.00
5/31/2004	12:00	65.6	0.00
5/31/2004	13:00	66.4	0.00
5/31/2004	14:00	66.6	0.00
5/31/2004	15:00	66.1	0.00
5/31/2004	16:00	66.8	0.00
5/31/2004	17:00	67.5	0.00
6/01//2004	07:00	65.5	0.00
6/01//2004	08:00	68.0	0.00
6/01//2004	09:00	70.3	0.00
6/01//2004	10:00	72.9	0.00
6/01//2004	11:00	73.1	0.00
6/01//2004	12:00	78.2	0.00
6/01//2004	13:00	79.4	0.00
6/01//2004	14:00	77.5	0.00
6/01//2004	15:00	74.5	0.00
6/01//2004	16:00	64.2	0.00
6/01//2004	17:00	68.5	0.00
6/02/2004	07:00	62.3	0.00
6/02/2004	08:00	67.1	0.00
6/02/2004	09:00	71.9	0.00
6/02/2004	10:00	74.0	0.00
6/02/2004	11:00	76.3	0.00
6/02/2004	12:00	78.5	0.00
6/02/2004	13:00	79.4	0.00
6/02/2004	14:00	79.5	0.00
6/02/2004	15:00	76.0	0.00
6/02/2004	16:00	74.0	0.00
6/02/2004	17:00	76.5	0.00
6/03/2004	07:00	64.3	0.00
6/03/2004	08:00	67.8	0.00
6/03/2004	09:00	69.9	0.00
6/03/2004	10:00	72.4	0.00
6/03/2004	11:00	73.0	0.00
6/03/2004	12:00	74.5	0.00
6/03/2004	13:00	76.1	0.00
6/03/2004	14:00	77.4	0.00
6/03/2004	15:00	77.9	0.00
6/03/2004	16:00	77.9	0.00
6/03/2004	17:00	78.4	0.00

TABLE B-1. (CONT'D)

Date	Time	Average Temperature, °F	Total Precip., (in.)
6/04//2004	07:00	64.6	0.00
6/04//2004	08:00	65.9	0.00
6/04//2004	09:00	67.4	0.00
6/04//2004	10:00	69.0	0.00
6/04//2004	11:00	70.9	0.00
6/04//2004	12:00	72.5	0.00
6/04//2004	13:00	72.6	0.00
6/04//2004	14:00	72.2	0.00
6/04//2004	15:00	71.1	0.00
6/04//2004	16:00	70.4	0.00
6/04//2004	17:00	69.3	0.00

APPENDIX C. SOIL MOISTURE

Date: 24 May 2004
Time: 0715 through 1700 hours

Probe Location	Layer, in.	AM Reading, %	PM Reading, %
Wet Area	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		
Wooded Area	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		
Open Area	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		
Calibration Lanes	0 to 6	39.2	39.0
	6 to 12	37.5	38.0
	12 to 24	1.5	1.6
	24 to 36	4.2	4.1
	36 to 48	5.3	5.5
Blind Grid/Moguls	0 to 6	3.2	3.0
	6 to 12	23.5	23.6
	12 to 24	38.2	39.0
	24 to 36	36.9	37.3
	36 to 48	38.2	38.1

Date: 25 May 2004
Time: 0715 through 1700 hours

Probe Location	**Layer, in.**	**AM Reading, %**	**PM Reading, %**
Wet Area	0 to 6	60.3	50.6
	6 to 12	74.2	60.1
	12 to 24	76.9	74.5
	24 to 36	54.9	77.3
	36 to 48	50.3	55.3
Wooded Area	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		
Open Area	0 to 6	21.9	21.6
	6 to 12	6.3	5.8
	12 to 24	18.1	18.0
	24 to 36	26.8	27.3
	36 to 48	51.9	52.6
Calibration Lanes	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		
Blind Grid/Moguls	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		

Date: 27 May 2004
Time: 0715 through 1700 hours

Probe Location	Layer, in.	AM Reading, %	PM Reading, %
Wet Area	0 to 6	60.8	60.4
	6 to 12	75.7	75.9
	12 to 24	77.2	77.0
	24 to 36	56.6	56.2
	36 to 48	49.5	50.0
Wooded Area	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		
Open Area	0 to 6	21.5	21.2
	6 to 12	5.4	5.8
	12 to 24	18.9	19.3
	24 to 36	27.6	27.9
	36 to 48	52.1	52.4
Calibration Lanes	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		
Blind Grid/Moguls	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		

Date: 28 May 2004
Time: 0715 through 1700 hours

Probe Location	Layer, in.	AM Reading, %	PM Reading, %
Wet Area	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		
Wooded Area	0 to 6	15.2	15.0
	6 to 12	5.8	6.0
	12 to 24	4.7	4.5
	24 to 36	52.3	52.4
	36 to 48	54.3	54.9
Open Area	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		
Calibration Lanes	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		
Blind Grid/Moguls	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		

Date: 29 May 2004
Time: 0715 through 1700 hours

Probe Location	**Layer, in.**	**AM Reading, %**	**PM Reading, %**
Wet Area	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		
Wooded Area	0 to 6	15.4	15.3
	6 to 12	6.3	6.4
	12 to 24	4.8	4.8
	24 to 36	52.9	53.2
	36 to 48	55.4	55.7
Open Area	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		
Calibration Lanes	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		
Blind Grid/Moguls	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		

Date: 1 June 2004
Time: 0715 through 1700 hours

Probe Location	Layer, in.	AM Reading, %	PM Reading, %
Wet Area	0 to 6	60.4	60.2
	6 to 12	75.9	76.2
	12 to 24	77.0	77.3
	24 to 36	56.2	56.1
	36 to 48	50.0	50.6
Wooded Area	0 to 6	15.3	15.2
	6 to 12	6.4	6.5
	12 to 24	4.8	5.3
	24 to 36	53.2	53.6
	36 to 48	55.7	56.1
Open Area	0 to 6	21.2	21.0
	6 to 12	5.8	5.9
	12 to 24	19.3	19.7
	24 to 36	27.9	28.3
	36 to 48	52.4	52.7
Calibration Lanes	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		
Blind Grid/Moguls	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		

Date: 2 June 2004
Time: 0715 through 1700 hours

Probe Location	Layer, in.	AM Reading, %	PM Reading, %
Wet Area	0 to 6	59.4	59.2
	6 to 12	76.8	77.1
	12 to 24	77.1	77.4
	24 to 36	56.8	57.2
	36 to 48	50.4	50.8
Wooded Area	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		
Open Area	0 to 6	21.0	21.1
	6 to 12	5.9	6.2
	12 to 24	19.7	20.1
	24 to 36	28.3	28.4
	36 to 48	52.7	53.0
Calibration Lanes	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		
Blind Grid/Moguls	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		

Date: 3 June 2004
Time: 0715 through 1700 hours

Probe Location	Layer, in.	AM Reading, %	PM Reading, %
Wet Area	0 to 6	59.4	59.2
	6 to 12	77.4	77.2
	12 to 24	77.3	77.1
	24 to 36	57.5	57.2
	36 to 48	51.7	52.0
Wooded Area	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		
Open Area	0 to 6	21.1	21.3
	6 to 12	6.2	6.4
	12 to 24	20.1	20.3
	24 to 36	28.4	28.9
	36 to 48	53.0	53.1
Calibration Lanes	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		
Blind Grid/Moguls	0 to 6	3.6	3.2
	6 to 12	23.5	23.8
	12 to 24	36.7	37.1
	24 to 36	35.4	35.2
	36 to 48	38.1	38.3

Date: 4 June 2004
Time: 0715 through 1700 hours

Probe Location	Layer, in.	AM Reading, %	PM Reading, %
Wet Area	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		
Wooded Area	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		
Open Area	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		
Calibration Lanes	0 to 6	NA	NA
	6 to 12		
	12 to 24		
	24 to 36		
	36 to 48		
Blind Grid/Moguls	0 to 6	3.5	3.2
	6 to 12	24.3	23.8
	12 to 24	37.5	37.4
	24 to 36	35.7	35.4
	36 to 48	38.4	38.8

APPENDIX D. DAILY ACTIVITY LOGS

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration, min	Operational Status	OP Stat Code	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
5/24/2004	5	CALIBRATION LANE	800	1215	255	INITIAL MOBILIZATION	1	INITIAL MOBILIZATION	GPS	NA	LINEAR	SUNNY	MUDDY
5/24/2004	5	CALIBRATION LANE	1215	1245	30	LUNCH/BREAK	5	LUNCH/BREAK	GPS	NA	LINEAR	SUNNY	MUDDY
5/24/2004	5	CALIBRATION LANE	1245	1330	45	INITIAL MOBILIZATION	1	INITIAL MOBILIZATION	GPS	NA	LINEAR	SUNNY	MUDDY
5/24/2004	5	CALIBRATION LANE	1330	1445	75	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/24/2004	5	BLIND TEST GRID	1445	1500	15	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
5/24/2004	5	BLIND TEST GRID	1500	1530	30	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/24/2004	5	BLIND TEST GRID	1530	1555	25	DOWNTIME MAINTENANCE CHECK	7	CHANGE BATTERY	GPS	NA	LINEAR	SUNNY	MUDDY
5/24/2004	5	BLIND TEST GRID	1555	1630	35	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/24/2004	5	CALIBRATION LANE	1630	1640	10	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
5/24/2004	5	CALIBRATION LANE	1640	1705	25	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/24/2004	5	CALIBRATION LANE	1705	1725	20	DAILY START/STOP	3	END OF DAILY OPERATIONS	GPS	NA	LINEAR	SUNNY	MUDDY
5/25/2004	5	OPEN FIELD	755	855	60	DAILY START/STOP	3	START OF DAILY OPERATIONS	GPS	NA	LINEAR	SUNNY	MUDDY
5/25/2004	5	OPEN FIELD	855	915	20	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/25/2004	5	OPEN FIELD	915	920	5	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
5/25/2004	5	OPEN FIELD	920	940	20	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/25/2004	5	OPEN FIELD	940	945	5	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY

Note: Activities pertinent to this specific demonstration are indicated in highlighted text.

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration, min	Operational Status	OP Stat Code	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
5/25/2004	5	OPEN FIELD	945	1005	20	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/25/2004	5	OPEN FIELD	1005	1015	10	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
5/25/2004	5	OPEN FIELD	1015	1040	25	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/25/2004	5	OPEN FIELD	1040	1050	10	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
5/25/2004	5	OPEN FIELD	1050	1110	20	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/25/2004	5	OPEN FIELD	1110	1120	10	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
5/25/2004	5	OPEN FIELD	1120	1140	20	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/25/2004	5	OPEN FIELD	1140	1150	10	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
5/25/2004	5	OPEN FIELD	1150	1215	25	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/25/2004	5	OPEN FIELD	1215	1315	60	LUNCH/BREAK	5	LUNCH/BREAK	GPS	NA	LINEAR	SUNNY	MUDDY
5/25/2004	5	OPEN FIELD	1315	1340	25	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/25/2004	5	OPEN FIELD	1340	1350	10	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
5/25/2004	5	OPEN FIELD	1350	1405	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/25/2004	5	OPEN FIELD	1405	1415	10	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
5/25/2004	5	OPEN FIELD	1415	1430	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/25/2004	5	OPEN FIELD	1430	1445	15	DOWNTIME MAINTENANCE CHECK	7	CHANGE BATTERY	GPS	NA	LINEAR	SUNNY	MUDDY

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration, min	Operational Status	OP Stat Code	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
5/25/2004	5	OPEN FIELD	1445	1455	10	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
5/25/2004	5	OPEN FIELD	1455	1515	20	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/25/2004	5	OPEN FIELD	1515	1520	5	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
5/25/2004	5	OPEN FIELD	1520	1535	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/25/2004	5	OPEN FIELD	1535	1540	5	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
5/25/2004	5	OPEN FIELD	1540	1600	20	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
5/25/2004	5	OPEN FIELD	1600	1615	15	DAILY START/STOP	3	END OF DAILY OPERATIONS	GPS	NA	LINEAR	SUNNY	MUDDY
5/26/2004	5	OPEN FIELD	750	1150	240	DAILY START/STOP	3	START OF DAILY OPERATIONS, SET UP GRIDS	GPS	NA	LINEAR	CLOUDY	RAIN
5/26/2004	5	OPEN FIELD	1150	1250	60	LUNCH/BREAK	5	LUNCH/BREAK	GPS	NA	LINEAR	CLOUDY	RAIN
5/26/2004	5	OPEN FIELD	1250	1310	20	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	CLOUDY	RAIN
5/26/2004	5	OPEN FIELD	1310	1330	20	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	CLOUDY	RAIN
5/26/2004	5	OPEN FIELD	1330	1500	90	LUNCH/BREAK	5	LUNCH/BREAK	GPS	NA	LINEAR	CLOUDY	RAIN
5/26/2004	5	OPEN FIELD	1500	1515	15	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	CLOUDY	RAIN
5/26/2004	5	OPEN FIELD	1515	1540	25	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	CLOUDY	RAIN
5/26/2004	5	OPEN FIELD	1540	1545	15	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	CLOUDY	RAIN
5/26/2004	5	OPEN FIELD	1545	1605	20	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	CLOUDY	RAIN

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration, min	Operational Status	OP Stat Code	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
5/26/2004	5	OPEN FIELD	1605	1610	5	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	CLOUDY	RAIN
5/26/2004	5	OPEN FIELD	1610	1625	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	CLOUDY	RAIN
5/26/2004	5	OPEN FIELD	1625	1630	5	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	CLOUDY	RAIN
5/26/2004	5	OPEN FIELD	1630	1645	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	CLOUDY	RAIN
5/26/2004	5	OPEN FIELD	1645	1705	20	DAILY START/STOP	3	END OF DAILY OPERATIONS	GPS	NA	LINEAR	CLOUDY	RAIN
5/27/2004	5	OPEN FIELD	755	815	20	DAILY START/STOP	3	START OF DAILY OPERATIONS	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	815	830	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	830	835	5	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	835	845	10	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	845	850	5	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	850	905	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	905	910	5	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	910	925	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	925	930	5	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	930	945	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	945	950	5	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	CLOUDY	MUDDY

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration, min	Operational Status	OP Stat Code	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
5/27/2004	5	OPEN FIELD	950	1005	15	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	1005	1010	5	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	1010	1025	15	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	1025	1105	40	LUNCH/BREAK	5	LUNCH/BREAK	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	1105	1110	5	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	1110	1125	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	1125	1130	5	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	1130	1145	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	1145	1150	5	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	1150	1155	5	DOWNTIME MAINTENANCE CHECK	7	CHANGE BATTERY	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	1155	1210	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	1210	1215	5	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	1215	1230	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	1230	1340	70	LUNCH/BREAK	5	LUNCH/BREAK	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	1340	1400	20	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	CLOUDY	MUDDY

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration, min	Operational Status	OP Stat Code	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
5/27/2004	5	OPEN FIELD	1400	1410	10	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	1410	1420	10	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	1420	1425	5	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	1425	1440	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	1440	1445	5	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	1445	1505	20	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	1505	1515	10	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	1515	1530	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	1530	1535	5	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	1535	1555	20	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	1555	1600	5	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	1600	1615	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	CLOUDY	MUDDY
5/27/2004	5	OPEN FIELD	1615	1700	45	DAILY START/STOP	3	END OF DAILY OPERATIONS	GPS	NA	LINEAR	CLOUDY	MUDDY
5/28/2004	4	WOODS	800	1115	195	DAILY START/STOP	3	SET UP RTS SYSTEM	RTS	NA	LINEAR	CLOUDY	MUDDY
5/28/2004	4	WOODS	1115	1145	30	COLLECT DATA	4	COLLECT DATA	RTS	NA	LINEAR	CLOUDY	MUDDY
5/28/2004	4	WOODS	1145	1150	5	DAILY START/STOP	3	SET UP, MOVE CABLES	RTS	NA	LINEAR	CLOUDY	MUDDY

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration, min	Operational Status	OP Stat Code	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
5/28/2004	4	WOODS	1150	1255	65	LUNCH/BREAK	5	LUNCH/BREAK	RTS	NA	LINEAR	CLOUDY	MUDDY
5/28/2004	4	WOODS	1255	1310	15	COLLECT DATA	4	COLLECT DATA	RTS	NA	LINEAR	CLOUDY	MUDDY
5/28/2004	4	WOODS	1310	1315	5	DAILY START/STOP	3	SET UP, MOVE CABLES	RTS	NA	LINEAR	CLOUDY	MUDDY
5/28/2004	4	WOODS	1315	1340	25	COLLECT DATA	4	COLLECT DATA	RTS	NA	LINEAR	CLOUDY	MUDDY
5/28/2004	4	WOODS	1340	1350	10	DAILY START/STOP	3	SET UP, MOVE CABLES	RTS	NA	LINEAR	CLOUDY	MUDDY
5/28/2004	4	WOODS	1350	1530	100	DAILY START/STOP	3	SET UP, MOVE RTS	RTS	NA	LINEAR	CLOUDY	MUDDY
5/28/2004	4	WOODS	1530	1600	30	COLLECT DATA	4	COLLECT DATA	RTS	NA	LINEAR	CLOUDY	MUDDY
5/28/2004	4	WOODS	1600	1630	30	DAILY START/STOP	3	END OF DAILY OPERATIONS	RTS	NA	LINEAR	CLOUDY	MUDDY
5/29/2004	4	WOODS	805	835	35	DAILY START/STOP	3	START OF DAILY OPERATIONS	RTS	NA	LINEAR	SUNNY	MUDDY
5/29/2004	4	WOODS	835	900	25	COLLECT DATA	4	COLLECT DATA	RTS	NA	LINEAR	SUNNY	MUDDY
5/29/2004	4	WOODS	900	1145	165	DAILY START/STOP	3	SET UP, CABLES, MOVE RTS	RTS	NA	LINEAR	SUNNY	MUDDY
5/29/2004	4	WOODS	1145	1315	90	COLLECT DATA	4	COLLECT DATA	RTS	NA	LINEAR	SUNNY	MUDDY
5/29/2004	4	WOODS	1315	1415	60	LUNCH/BREAK	5	LUNCH/BREAK	RTS	NA	LINEAR	SUNNY	MUDDY
5/29/2004	4	WOODS	1415	1445	30	DOWNTIME MAINTENANCE CHECK	7	DATA CHECK	RTS	NA	LINEAR	SUNNY	MUDDY
5/29/2004	4	WOODS	1445	1500	15	COLLECT DATA	4	COLLECT DATA	RTS	NA	LINEAR	SUNNY	MUDDY
5/29/2004	4	WOODS	1500	1520	20	DAILY START/STOP	3	SET UP, MOVE CABLES	RTS	NA	LINEAR	SUNNY	MUDDY

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration, min	Operational Status	OP Stat Code	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
5/29/2004	4	WOODS	1520	1600	40	COLLECT DATA	4	COLLECT DATA	RTS	NA	LINEAR	SUNNY	MUDDY
5/29/2004	4	WOODS	1600	1620	20	EQUIPMENT FAILURE	6	DEAD RTS BATTERY, NO REPLACEMENT	RTS	NA	LINEAR	SUNNY	MUDDY
5/29/2004	4	WOODS	1620	1640	20	DAILY START/STOP	3	END OF DAILY OPERATIONS	RTS	NA	LINEAR	SUNNY	MUDDY
6/1/2004	4	WOODS	810	845	35	DAILY START/STOP	3	START OF DAILY OPERATIONS	RTS	NA	LINEAR	SUNNY	MUDDY
6/1/2004	4	WOODS	845	1035	110	COLLECT DATA	4	COLLECT DATA	RTS	NA	LINEAR	SUNNY	MUDDY
6/1/2004	4	WOODS	1035	1100	25	DOWNTIME MAINTENANCE CHECK	7	DATA CHECK	RTS	NA	LINEAR	SUNNY	MUDDY
6/1/2004	4	WOODS	1100	1120	20	COLLECT DATA	4	COLLECT DATA	RTS	NA	LINEAR	SUNNY	MUDDY
6/1/2004	4	WOODS	1120	1205	45	DAILY START/STOP	3	SET UP, MOVE RTS	RTS	NA	LINEAR	SUNNY	MUDDY
6/1/2004	4	WOODS	1205	1310	65	COLLECT DATA	4	COLLECT DATA	RTS	NA	LINEAR	SUNNY	MUDDY
6/1/2004	4	WOODS	1310	1425	75	LUNCH/BREAK	5	LUNCH/BREAK	RTS	NA	LINEAR	SUNNY	MUDDY
6/1/2004	4	WOODS	1425	1455	30	DOWNTIME MAINTENANCE CHECK	7	DATA CHECK	RTS	NA	LINEAR	SUNNY	MUDDY
6/1/2004	4	OPEN FIELD	1455	1530	35	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
6/1/2004	4	OPEN FIELD	1530	1545	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/1/2004	4	OPEN FIELD	1545	1605	20	DAILY START/STOP	3	END OF DAILY OPERATIONS	GPS	NA	LINEAR	SUNNY	MUDDY
6/1/2004	4	OPEN FIELD	755	855	60	DAILY START/STOP	3	START OF DAILY OPERATIONS	GPS	NA	LINEAR	SUNNY	MUDDY
6/1/2004	4	OPEN FIELD	855	910	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/1/2004	4	OPEN FIELD	910	915	5	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration, min	Operational Status	OP Stat Code	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
6/2/2004	4	OPEN FIELD	915	1025	70	LUNCH/BREAK	5	LUNCH/BREAK	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1025	1035	10	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1035	1050	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1050	1105	15	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1105	1115	10	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1115	1135	20	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1135	1145	10	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1145	1205	20	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1205	1215	10	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1215	1225	10	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1225	1230	5	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1230	1245	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1245	1340	55	LUNCH/BREAK	5	LUNCH/BREAK	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1340	1350	10	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1350	1405	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1405	1410	5	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1410	1420	10	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration, min	Operational Status	OP Stat Code	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
6/2/2004	4	OPEN FIELD	1420	1430	10	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1430	1440	10	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1440	1450	10	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1450	1510	20	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1510	1520	10	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1520	1525	5	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1525	1535	10	WEATHER	8	RAIN	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1535	1540	5	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1540	1550	10	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1550	1600	10	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1600	1610	10	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1610	1625	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1625	1640	15	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1640	1655	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/2/2004	4	OPEN FIELD	1655	1715	20	DAILY START/STOP	3	END OF DAILY OPERATIONS	GPS	NA	LINEAR	SUNNY	MUDDY
6/3/2004	4	OPEN FIELD	805	840	25	DAILY START/STOP	3	START OF DAILY OPERATIONS	GPS	NA	LINEAR	SUNNY	MUDDY
6/3/2004	4	OPEN FIELD	840	850	10	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration, min	Operational Status	OP Stat Code	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
6/3/2004	4	OPEN FIELD	850	855	5	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
6/3/2004	4	OPEN FIELD	855	910	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/3/2004	4	OPEN FIELD	910	915	5	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
6/3/2004	4	OPEN FIELD	915	920	5	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/3/2004	4	OPEN FIELD	920	945	25	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
6/3/2004	4	OPEN FIELD	945	1005	20	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/3/2004	4	OPEN FIELD	1005	1025	20	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
6/3/2004	4	OPEN FIELD	1025	1040	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/3/2004	4	OPEN FIELD	1040	1045	5	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
6/3/2004	4	OPEN FIELD	1045	1100	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/32004	4	MOGUL AREA	1100	1110	10	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
6/32004	4	MOGUL AREA	1110	1130	20	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/32004	4	MOGUL AREA	1130	1150	20	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
6/32004	4	MOGUL AREA	1150	1305	75	LUNCH/BREAK	5	LUNCH/BREAK	GPS	NA	LINEAR	SUNNY	MUDDY
6/32004	4	MOGUL AREA	1305	1325	20	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/32004	4	MOGUL AREA	1325	1350	25	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
6/32004	4	MOGUL AREA	1350	1415	25	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY

Date	No. of People	Area Tested	Status Start Time	Status Stop Time	Duration, min	Operational Status	OP Stat Code	Operational Status - Comments	Track Method	Track Method=Other Explain	Pattern	Field Conditions	
6/32004	4	MOGUL AREA	1415	1430	15	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
6/32004	4	MOGUL AREA	1430	1445	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/32004	4	MOGUL AREA	1445	1455	10	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
6/32004	4	MOGUL AREA	1455	1505	10	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/32004	4	MOGUL AREA	1505	1515	10	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
6/32004	4	MOGUL AREA	1515	1530	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/32004	4	MOGUL AREA	1530	1550	20	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	SUNNY	MUDDY
6/32004	4	MOGUL AREA	1550	1615	25	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	SUNNY	MUDDY
6/3/2004	4	MOGUL AREA	1615	1645	30	DAILY START/STOP	3	END OF DAILY OPERATIONS	GPS	NA	LINEAR	SUNNY	MUDDY
6/4/2004	4	BLIND TEST GRID	1000	1010	10	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	CLOUDY	MUDDY
6/4/2004	4	BLIND TEST GRID	1010	1025	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	CLOUDY	MUDDY
6/4/2004	4	BLIND TEST GRID	1025	1030	5	DAILY START/STOP	3	SET UP, MOVE CABLES	GPS	NA	LINEAR	CLOUDY	MUDDY
6/4/2004	4	BLIND TEST GRID	1030	1045	15	COLLECT DATA	4	COLLECT DATA	GPS	NA	LINEAR	CLOUDY	MUDDY
6/4/2004	4	BLIND TEST GRID	1045	1110	25	LUNCH/BREAK	5	LUNCH/BREAK	GPS	NA	LINEAR	CLOUDY	MUDDY
6/4/2004	4	BLIND TEST GRID	1110	1215	75	DEMOBILIZATION	10	DEMOBILIZATION	GPS	NA	LINEAR	CLOUDY	MUDDY
6/4/2004	4	BLIND TEST GRID	1215	1315	60	LUNCH/BREAK	5	LUNCH/BREAK	GPS	NA	LINEAR	CLOUDY	MUDDY
6/4/2004	4	BLIND TEST GRID	1315	1530	135	DEMOBILIZATION	10	DEMOBILIZATION	GPS	NA	LINEAR	CLOUDY	MUDDY

Note: Activities pertinent to this specific demonstration are indicated in highlighted text.

APPENDIX E. REFERENCES

1. Standardized UXO Technology Demonstration Site Handbook, DTC Project No. 8-CO-160-000-473, Report No. ATC-8349, March 2002.

2. Aberdeen Proving Ground Soil Survey Report, October 1998.

3. Data Summary, UXO Standardized Test Site: APG Soils Description, May 2002.

4. Yuma Proving Ground Soil Survey Report, May 2003.

APPENDIX F. ABBREVIATIONS

AEC	=	U.S. Army Environmental Center
APG	=	Aberdeen Proving Ground
ATC	=	U.S. Army Aberdeen Test Center
CSV	=	comma separated values
DGPS	=	Digital Global Positioning System
HEAT	=	high-explosive, antitank
EM	=	electromagnetic
EMI	=	electromagnetic interference
ERDC	=	U.S. Army Corps of Engineers Engineering Research and Development Center
ESTCP	=	Environmental Security Technology Certification Program
EQT	=	Army Environmental Quality Technology Program
GPS	=	Global Positioning System
HEAT	=	high-explosive, antitank
JPG	=	Jefferson Proving Ground
POC	=	point of contact
QA	=	quality assurance
QC	=	quality control
RMS	=	root-mean-square
ROC	=	receiver-operating characteristic
RTK	=	real time kinematic
RTS	=	Robotic Total Station
SAM	=	Sub-Audio Magnetics
SERDP	=	Strategic Environmental Research and Development Program
TFEMI	=	Total Field Electromagnetic Introduction
TMI	=	Total Magnetic Intensity
UXO	=	unexploded ordnance
YPG	=	U.S. Army Yuma Proving Ground